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ENCEPHALOGRAPHY¹

A REVIEW OF 113 CASES, AND A REPORT OF POSTMORTEM STUDIES ON THE
INJECTION OF AIR

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ENCEPHALOGRAPHY as a diagnostic procedure has passed through many phases since its introduction by Dandy (2). The technic for the injection of air has become more or less standardized, but roentgenologic methods still vary. Pancoast and Fay (6) and Pendergrass (7) proposed a roentgenologic method for encephalography to standardize the procedure, thus permitting uniform interpretation. However, for a comparatively new procedure, no one method should be accepted as standard until various methods have been investigated thoroughly. In pursuance of this idea, we have developed at the University of California Hospital a procedure which is at some variance with that advocated as standard by the authors mentioned above. As this has proved highly satisfactory, it is believed to further the knowledge obtained from encephalography.

Many of the shadows seen in encephalograms have not been interpreted satisfactorily. An attempt is made to explain some of these by combining observations made on patients with experimental studies done on postmortem material.

INDICATIONS AND CONTRA-INDICATIONS

Encephalography is indicated as a complementary or supplementary diagnostic aid to neurologic examination in the following instances: First, when the clinical condition is not explained satisfactorily by the physical findings; second, when a more exact localization of the intracranial lesions, such as traumatic brain scars and brain tumors, is required; third, when a definite demonstration of the extent of a generalized brain lesion is desired.

This procedure should not be used for patients presenting clinical evidence of increased intracranial pressure, whether or not the evidence is associated with space-consuming lesions of the brain.

TECHNIC OF AIR INJECTIONS

The air injections were made under novocaine (locally), avertin, or ether anesthesia. When novocaine was used, a preliminary hypodermic injection of morphine sulphate was given; when avertin was used, morphine sulphate and scopolamine were the preliminary drugs.

With the patient in the sitting position and the head normally upright, two spinal puncture needles were introduced in the

¹Read before the Radiological Society of North America, at the Eighteenth Annual Meeting, at Atlantic City, Nov. 28-Dec. 1, 1932.

usual manner. To one needle was attached a three-way stop-cock, fitted with a Boulitte air manometer and an adapter for a Luer syringe. By means of the manometer, the pressure, which was measured initially, was

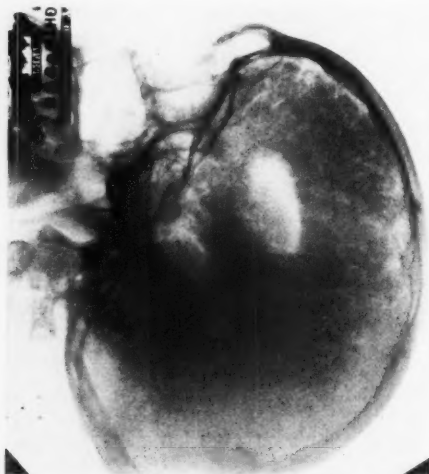


Fig. 1. Horizontal transverse projection, face up, showing the frontal horns well filled.

kept constant throughout the procedure. The fluid was allowed to escape from the second needle, was measured, and the air replaced approximately volume for volume. When air escaped from the second needle, the head was flexed, extended, and tilted slowly and repeatedly to insure as complete emptying of the ventricles as possible. On completion of the injections, the patient was placed on his back and taken immediately to the x-ray department.

ROENTGENOLOGIC TECHNIC

The patient was kept in the horizontal position and the first exposure was made immediately, in the vertical anteroposterior direction, with the face up and the occiput on the Bucky diaphragm. The usual precautions were taken to have the vertical beam directly parallel to the midsagittal plane and the ventricles thrown clear of the frontal sinuses. The film was developed at once to

see that sufficient air was present before the series was continued.

The second exposure was made with the x-ray beam directed horizontally through the head, the face still up, and the cassette

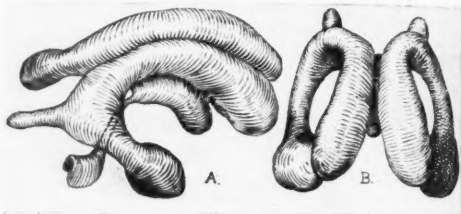


Fig. 2. Lateral and superior views of a cast of the human ventricles. Note the lateral flaring and downward curvature of the anterior horns.

placed vertically beside the head. The third view was a vertical postero-anterior projection, with the occiput up. The fourth exposure was made in the same direction as the second, but the occiput was up. The fifth and sixth exposures were vertical transverse projections, with alternate sides up. Special views were taken as indicated after the routine series was finished and examined. The Bucky diaphragm was used in all views except the horizontal transverse.

The second and fourth views, called horizontal transverse projections, were described first by Naffziger (4), in 1923, before the American Medical Association, but the paper was not published. Because the air rises to the highest point, the view made with the face up (Fig. 1) shows the anterior horns completely filled, even when the amount of air in the ventricles was comparatively small; that with the occiput up (Fig. 8) shows the posterior horns similarly. We feel that the shape, form, and position of an air-filled cavity, or any part of it, cannot be judged satisfactorily unless the part under consideration is filled completely with air and viewed in two directions, at right-angles to each other. The routine positions described usually accomplished this object. When any part was

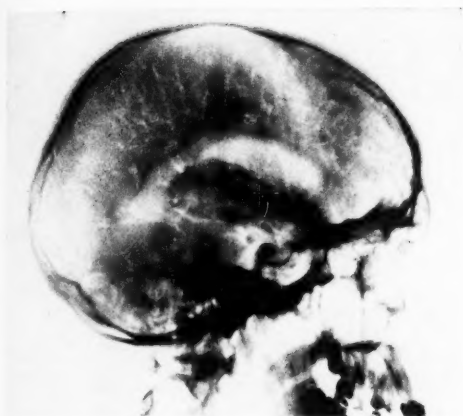


Fig. 3. Lateral projection, left side down, showing the general distribution of the air over the lateral surfaces of the hemispheres. Note the lack of complete correspondence between the pattern of the air shadows and that of the anatomic sulci of the brain.

filled incompletely in those positions, further exposures were made after so turning the patient as to allow the air to rise to the desired part of the cavity.

The horizontal position is preferable, therefore, to the upright, because each portion of the ventricles is shown completely filled in one or more of the films. This applies particularly to the frontal horns, which curve not only outward, but also downward toward the base (Fig. 2). In the usual anteroposterior view, with the patient upright, and his chin down, the air rises to the upper part of the body of the ventricles, and fluid settles in the tips of the frontal horns, which, therefore, are not demonstrated. The horizontal position is also preferable because thus the air is distributed more evenly over the entire cortex than it is in encephalograms made in the upright position (Fig. 3).

REVIEW OF CASES

The series here reported consists of 113 consecutive encephalographic studies made at the University of California Hospital between December, 1930, and September, 1932. In 14 additional cases, the studies

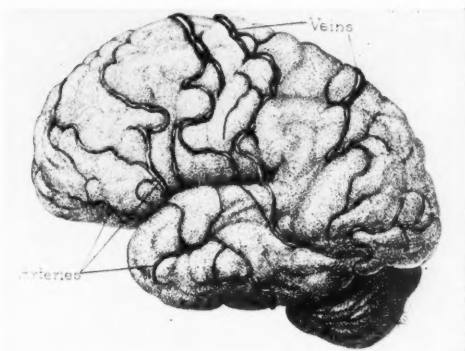


Fig. 4. Semi-diagrammatic drawing showing how the blood vessels cross the convolutions.

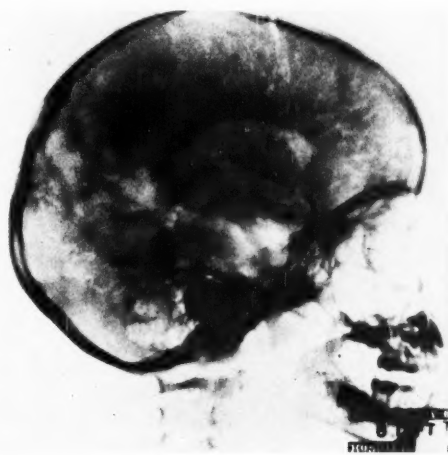


Fig. 5. Lateral projection, left side down. Note the irregular width of the subarachnoid channels, described as studding. This patient was mentally defective, a suspected case of aplasia. No other x-ray evidence was shown, except the studding and the 24-hour bubbles.

were inconclusive, either because of insufficient air in the cranium or because of unsatisfactory roentgenograms.

The average age of the patients examined was 25 years, the youngest being 10 months, the oldest, 65 years. The average amount of air injected was: For patients up to 6 years of age, 89 c.c.; for those from 6 to 15 years old, 103 c.c.; for those 16 years or older, 113 cubic centimeters.

One patient in this series died following

TABLE I.—ENCEPHALOGRAPHIC FINDINGS

| | Normal | En- larged | Not demon- strated |
|---------------------------------|--------|---------------|--------------------------|
| Cisterna magna | 85 | 19 | 9 |
| Cisterna pontis | 91 | 20 | 2 |
| Cisterna interpedun- cularis | 100 | 9 | 4 |
| Cisterna chiasmatica | 105 | 7 | 1 |
| Cisterna intercom- municans | 41 | 1 | 71 |
| Cisterna venæ magnæ cerebri | 64 | 6 | 43 |
| Subarachnoid chan- nels | | | |
| Right frontal lobe | 69 | 24 | 20 |
| Right parietal lobe | 58 | 20 | 35 |
| Right occipital lobe | 14 | 1 | 98 |
| Left frontal lobe | 69 | 26 | 18 |
| Left parietal lobe | 61 | 21 | 31 |
| Left occipital lobe | 13 | 1 | 99 |
| Midline | 71 | 4 | 38 |
| Under frontal | 33 | 5 | 75 |
| Ventricles | 75 | 31 | 7 |

the procedure. She was an elderly woman with high blood pressure, who presented a problem for differential diagnosis between a slowly progressing vascular lesion and a brain tumor. Death resulted from rapid progress of her vascular occlusion.

Table I records the frequency of the demonstration of the various parts of the cerebrospinal fluid pathways of the brain. The casts of these, prepared by Locke and Naffziger (3) were of great value in the interpretation of the roentgenographic shadows.

In Table II, the number of cases in each group and the clinical and roentgenographic diagnoses are listed. The roentgenographic diagnoses were based on the commonly accepted standards, with the following exceptions: The size of the basal cisterns was not interpreted as being significant except

when the cisterns were extremely large; in such instances, they always were associated with other findings. Large subdural air collections over the cortex were not interpreted as indicative of atrophy. This latter point will be discussed further. In all interpretations we endeavored to avoid overestimating doubtful findings, inasmuch as no sufficiently extensive studies correlating uncertain roentgenographic evidence with pathologic examinations have been recorded. It is apparent from this tabulation that the percentage of positive findings corresponds in general with that reported by others and with that found on pathologic examination.

Of 15 patients in whom clinical findings suggested the diagnosis of brain tumor, definite pathologic changes were shown in 11; six interpretations of brain tumor were verified; two interpretations of brain tumor have not been verified as yet; one patient was shown to have a porencephalic cyst; two were proved to have atrophy; four appeared normal. These findings are comparable to those reported by Adson (1) who showed that, of 16 brain tumor suspects, 9 cases were proved.

Of 27 patients in whom the clinical diagnosis was a convulsive state of unknown origin, 10 showed positive x-ray findings and 17 appeared normal. These findings are comparable to those reported by Notkin (5). He found that, in 17 patients, most of whom were in advanced stages of mental deterioration, positive x-ray findings were noted in nine and normal findings in eight.

Of 25 patients in whom there was a diagnosis of post-traumatic convulsive state, the x-ray findings were positive in 12; the appearance was normal in 13. The findings relative to the convulsive states correspond to those actually observed (9, 10). Pendergrass (7) reported some form of atrophy of the brain in all cases of convulsive state studied by him.

In a total of 14 cases of mentally defec-

TABLE II

| Clinical Diagnosis | Encephalographic Diagnosis | | | | | | | | Total Cases |
|---------------------------------|----------------------------|---------------|---------------|--------------------|-------|--------------------|----------------|--------|-------------|
| | Internal hydrocephalus | Cortical scar | Arachnoiditis | Aplasia or atrophy | Tumor | Porencephalic cyst | Total positive | Normal | |
| Brain tumor suspect | | | | 2 | 8 | 1 | 11 | 4 | 15 |
| Convulsive state (idiopathic) | | | 1 | 9 | | | 10 | 17 | 27 |
| Convulsive state (traumatic) | | 4 | 1 | 7 | | | 12 | 13 | 25 |
| Mental defective | 2 | | | 6 | | | 8 | 6 | 14 |
| Cerebral arteriosclerosis | 1 | | | 5 | | | 6 | 2 | 8 |
| Encephalitis | 2 | | 1 | 2 | | | 5 | 2 | 7 |
| Post-traumatic head syndrome | | 1 | | 2 | | | 3 | 4 | 7 |
| Degenerative diseases, C. N. S. | | | | 2 | | | 2 | 2 | 4 |
| Congenital hydrocephalus | 2 | | | | | | 2 | | 2 |
| Dementia præcox | | | | | | | | 1 | 1 |
| Congenital hemiatrophy | | | | 1 | | | 1 | | 1 |
| Otosclerosis | | | | | | | | 1 | 1 |
| Malignant exophthalmos | | | | | | | | 1 | 1 |

tive children, positive x-ray findings were seen in eight; the appearance was normal in six. These results are comparable to those reported by Winkler (12), who found that, of 78 patients who had been diagnosed as feeble-minded, 31 showed definite pathologic changes and 47 did not.

The foregoing review shows that the results obtained by the encephalographic method described are comparable to those obtained by others.

INTERPRETATION OF SUBARACHNOID AIR CHANNELS

Most authors have assumed that the subarachnoid air channels, as seen in the x-ray films, follow and outline the sulci of the brain. However, on careful analysis of these

shadows, it is clearly evident that, while many of them correspond to the sulci, others do not (Fig. 3). This observation was made by Winkler (11), who attempted to correlate it with anatomic findings by outlining the sulci with barium paste. He showed that the barium paste shadows of the sulci and the air channel shadows of the encephalograms did not correspond. In seeking an explanation for these discrepancies, a study was made of the cortical vessels. It was observed that, in general, the arteries and smaller veins follow the sulci, but at various points they pass directly across convolutions (Fig. 4). The larger cerebral veins, on either side of the midline, pass across both convolutions and sulci.

Experimental.—In order to demonstrate

the relationship of the subarachnoid air channels to the sulci and vessels, the following procedure was carried out postmortem.

Procedure 1.—The skull cap was removed and the dura was reflected, the hinge



Fig. 6. Horizontal transverse projection, face up, made 24 hours after the air injection, showing large 24-hour bubbles. This patient showed wide subarachnoid channels on immediate examination.

of the dural flap being along the longitudinal sinus. The subject then was placed in the sitting position and a routine spinal air injection was performed. As the air flowed upward, it passed along the sulci and over the convolutions. Its course over the convolutions was in channels beside the blood vessels. It remained in these, as well as in the sulci, a condition which was especially true about the large cerebral veins on either side of the longitudinal sinus. Thus it is obvious that the subarachnoid air shadows seen in the roentgenogram result from air in the channels crossing the convolutions, as well as from air in the sulci. Close to the midline, the air collections about the larger veins predominate over those in the sulci.

Clinical.—This explanation of the air shadows is helpful in interpreting other observations. In patients clinically suspected of early atrophy, we have observed that, in the lateral views, the linear air shadows are

not of uniform diameter, but present widened areas at intervals (Fig. 5). These are believed to be caused by air collections about a vessel at a point at which it leaves a sulcus to cross a convolution. This appearance, which has been termed "studding" of the subarachnoid air shadows, is considered to be an indication of early atrophy.

In cases of advanced atrophy, the air collected in the form of large bubbles, connected by smaller channels. In films made 24 hours after the injection, the air was in the form of isolated bubbles scattered irregularly over the cortex (Fig. 6). Upon reviewing the cases of mild atrophy with this in mind, it was discovered that the findings were the same, but of less degree. Some patients clinically suspected of mild atrophy, who did not show widened channels on immediate examination, did show these so-called 24-hour bubbles. It seems possible that the explanation of this condition is the same as that of the studding. In some cases it may be that it results from pocketings caused by arachnoiditis.

Of 54 patients who were examined at the end of 24 hours, 31 showed bubbles and 23 did not. In the 31 patients, other encephalographic findings established a diagnosis in 21, while in 10 there were no other definite findings. Six of these 10 were mentally defective patients. In the other 4, the clinical findings were such that the brain should have shown atrophy, but the widening of the subarachnoid channels was doubtful.

In the 23 patients in whom no 24-hour bubbles were noted, there were no other x-ray findings, or clinical evidence that such bubbles might be expected. It is, therefore, evident that a 24-hour examination is indicated for patients suspected of atrophy, if the immediate encephalograms do not evidence it.

INTERPRETATION OF SUPERFLUITANT AIR

Clinical Findings.—Encephalographic studies frequently show a large collection of

air over the cortex. This probably is best described as superfluitant air, first, because its anatomic position is somewhat in doubt, and, second, because it usually is accompanied by a fluid level. It has been referred to

In this series of 113 cases, superfluitant air collections were found initially in 44; of these, 18 had the wide subarachnoid channels, usually diagnosed as atrophy, while 26 did not have widened channels. From this



Fig. 7. Horizontal transverse projection, face up.



Fig. 8. Horizontal transverse projection, occiput up (same patient as shown in Figure 7). Figures 7 and 8 show a large superfluitant collection which moved freely from the frontal to the occipital pole. At operation for malignant exophthalmos, both frontal lobes were seen to be normal.

by some as subdural, and by others as subarachnoid, air, and has been interpreted as representing cortical atrophy. Our interest in the explanation of this finding was aroused when a patient showed it very definitely over the frontal and occipital lobes in the horizontal transverse encephalographic films (Figs. 7 and 8). At operation for malignant exophthalmos, both frontal lobes were exposed and were seen to be normal.

The x-ray examination by transverse projections, with the face up and with the occiput up alternately, provided a further means of study of the superfluitant air. It is demonstrated more frequently in the transverse positions than it is in the usual lateral views. These transverse views show that, when the patient is turned from the face-up to the occiput-up position, the superfluitant air moves freely from the frontal to the occipital pole. In roentgenograms made in the upright position, it usually is seen on either side of the midline at the vertex.

it is evident that the superfluitant air is not necessarily associated with atrophy.

Superfluitant air, which so frequently was present at the time of the initial examination, was increased in amount subsequently. Many times it was found at later examinations even when it had not been present initially. The immediate superfluitant air shadow is the same, except for size, as that seen at the 24-hour examination. This was substantiated by the findings in 65 patients who had films made at 24 hours, or later. Of these, in 19 no superfluitant air was noted at any examination; in four air was seen only at the initial examination; in 30 air was demonstrated immediately and an increased volume of it subsequently; in 13 no air was seen immediately, but it was present 24 hours, or more, later.

From these findings, it appears that at

least some of the air which is initially in the subarachnoid space is collected, immediately or later, as a superfluitant bubble. This being so, it is not possible to explain all of the superfluitant air collections as errors in sur-



Fig. 9. Anteroposterior projection with the patient upright, 24 hours after the air injection. Note the attachment of the arachnoid to the dura on either side of the midline. Note the superfluitant air and the fluid level.

gical technic, as hypothesized by Pendergrass (8).

Experimental Studies.—In a further effort to explain the finding, resort was had again to postmortem subjects.

Procedure 2.—The skull cap was removed carefully without tearing the dura. The subject was placed in the sitting position, and a routine spinal air injection was performed. The cranium then was immersed in water and the dura was opened carefully, precaution being taken not to rupture the arachnoid. When the dura was opened under water, it was noted that no air escaped.

On reflecting the dura, the air was found to be in the subarachnoid channels. On rupturing the arachnoid membrane, air escaped.

Procedure 3.—The skull cap was removed without tearing the dura. A lumbar laminectomy was performed, exposing the spinal dura. The subject was placed in the sitting position. The spinal dura was opened carefully without rupturing the arachnoid, and air was injected between the spinal dura and the arachnoid. The air appeared rapidly beneath the dura overlying the cortex of the brain. The dura then was reflected, and no air was seen in the cortical subarachnoid space.

It is, therefore, possible for air injected into the spinal subdural space to appear over the cortex in the form of a large air collection beneath the dura. The fact that the superfluitant air, found in encephalograms, increases for some hours after the air injection and is most marked in films made after 24 hours, is not consistent with the explanation that the air was injected subdurally accidentally.

It was observed in the foregoing postmortem studies that a very slight pull of the dura caused a stretching of the arachnoid at the points at which the arachnoidal granulations pierce the dura. Such a pull caused the arachnoidal membrane to rupture at those points, allowing the escape of the subarachnoid air into the subdural space.

Encephalograms showing large superfluitant air accumulations also show the arachnoidal membrane, which has the appearance of being stretched, extending down from the under surface of the dura to the cortex in a tent-like fashion (Fig. 9). The horizontal transverse views show that, when the head is rotated from the face-up to the occiput-up position, the brain settles to the lowest point and the superfluitant air rises to the opposite pole. Thus it is shown that the brain can move when the cerebrospinal fluid is replaced by air. This mobility, together with the apparent stretching, readily could

cause a rupture of the arachnoidal membrane similar to that produced experimentally. Subarachnoid air, then, could escape into the subdural space. This is offered as a possible explanation of the mechanism of the production of superfluitant air.

It has been observed at necropsies and operations that, in some instances, sufficient fluid was present in the subarachnoid space to separate the arachnoidal membrane from the pia mater over the surface of some convolutions. This observation made it seem possible that the subarachnoid space might be sufficiently distensible at times to allow superfluitant air to collect in it. It was shown, however, in the postmortem subjects examined, that this fluid did not flow freely from one place to another. When the fluid was withdrawn and air injected, it likewise did not flow from one area to another. So far as these observations have been made, it seems improbable that superfluitant air, as it is usually observed, can be in the subarachnoid space.

CONCLUSIONS

1. Encephalograms made with the patient in the horizontal position are satisfactory.
2. Horizontal transverse projections are of distinct advantage.
3. The cortical air markings seen in encephalograms result from air in the sulci and along blood vessels over the convolutions.

4. Multiple small bubbles of air over the cortex, demonstrated in films made 24 hours after the air injection, are indicative of atrophy, aplasia, or arachnoiditis.

5. Superfluitant air, which is usually subdural, does not indicate atrophy.

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METHODS OF ROENTGEN TREATMENT IN CARCINOMA OF THE BREAST¹

REPORT OF 210 CASES

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DUE to its rapid progress, roentgen therapy has heretofore failed to show that degree of standardization which is so much admired in surgery. It evidently has not yet left the stage of experimentation. Nevertheless, though we are not at present able to explain the most fundamental biological reactions, recent communications are indicating that we have reached a point where we can decide as to the best method of treatment available. This statement holds true in cancer of the cervix, and also, to a lesser degree, in cancer of the breast. A considerable amount of material concerning results has been obtained from all parts of the world, but these statistics vary so much in their basic principles that they cannot be compared to best advantage. Lynham has ably pointed out that, if a few surgeons and radiologists of each country would get together and gather their material with the same basic understanding as to registration of cases and different methods of treatment, it would be easy to obtain enough data within a few years, clearly to establish the value of each particular method of treatment. In Europe, the Steinthal registration has been adopted. Its Group I and Group II are identical with those of the American College of Surgeons; as Group III, Steinthal registers all inoperable cases, including those with supraclavicular glands, and inoperable recurrences, whereas Group III of the American classification comprises operable local recurrences, and Group IV, inoperable local recurrences.

The statistics of the last ten years have

clearly established the fact that roentgen therapy, following the operation for cancer of the breast, has raised the percentage of five-year cures considerably. In inoperable and recurrent cases, it is indispensable. As a pre-operative procedure, it appears to be gaining increasing favor. Recent reports seem to indicate that further improvement in results may be expected by combination with interstitial radium application, according to Keynes' method. Occasional good individual results have already been obtained, in the early stages, and with a primitive equipment. With growing experience and the advancement of x-ray science, the figures have become consistently better, especially within the last decade. In the course of this development, many methods of treatment have been presented and later abandoned. Every radiotherapist has done his share of pioneering, and has tried to improve upon the different methods. This may be the reason why the number of methods in use is considerable, especially in the treatment of cancer of the breast.

A part of this diversity is due to the fact that comparatively few authors have described their method so that it can be followed according to their specifications. In this country, the lack of a text-book on the different methods, unifying technic, written by a competent author, is felt keenly. If a surgeon describes a new operation, he goes into minute details of manipulation, so that the reader may be able to imitate them, step by step. Unfortunately, in radiotherapy, most authors take too many things for granted, leaving many factors to the imagination of their fellow-radiologists. To copy a method of x-ray treatment is more com-

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plicated than to copy a surgical procedure. The treatment can be varied as to the following factors: (1) Potential and current; (2) filter; (3) focus-skin distance; (4) size and number of areas treated; (5) direction of each beam of rays; (6) single and total amounts of r units given to each field; (7) distribution of the treatments over a shorter or longer space of time; (8) maintenance of saturation over varying periods.

To accomplish a thorough and homogeneous radiation of the entire chest area for the treatment of carcinoma of the breast is one of the most difficult tasks in radiotherapy. Although the disease is located more or less near the surface of the body, the thinness of the chest wall, and the close proximity of the lung tissue, from which only little additional scattered radiation can be expected, offer the greatest difficulty in obtaining a homogeneous distribution of the rays. Furthermore, both heart and lungs are appreciably more sensitive to repeated radiation, and demand avoidance of damage as much as possible. As the rays covering the area of treatment penetrate through a large volume of tissue, great damage may be done to the entire system by intoxication from the radiation products. The damage may be so severe that the general resistance of the body to the cancer is lowered. For these reasons, the treatment must be confined to the areas actually affected.

Every method attempts to comply with these requirements, but with varying success. They all may be brought into two groups, the direct method and the tangential method. In the direct method, the rays are centered over the chest; in the tangential method, the beams are applied in such a way that they strike the chest wall tangentially. In the direct method either the small-field or the large-field technic is used, at either high or low voltage. In the treatment of small fields, areas of 6×8 to 10×15 centimeters are closely placed, one next to another, until the entire chest wall is cov-

ered. I believe it is generally accepted that this method is antiquated, and should be abandoned, even if low voltage and light filtration are used. It is impossible to place one field so close to the other that the entire

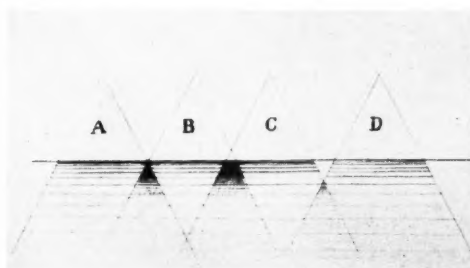


Fig. 1. Schematic drawing of the errors which can be made in the direct method, using small fields. Beams *A* and *B* meet perfectly on the surface, but their crossing in the depth produces an overdose. Beams *B* and *C* overlap on the surface, producing an overdose there as well as in the depth. Beams *C* and *D* are too far apart, leaving an area unirradiated.

area receives an even radiation. If the fields overlap, a burn will result. If they are too far apart, the area between does not receive enough radiation. Jüngling has demonstrated that a recurrence will spring from such an area. In his case, an area of only four-tenths of a centimeter was not sufficiently radiated, yet it was there that the recurrence originated. In the deeper tissue, the two beams cross each other, producing an overdose. Many cases of induration of the lungs or heart result from this method. It is far better, therefore, to radiate the entire chest wall with one field at a greater distance, and include the supraclavicular space in this area, or radiate the latter separately. Some roentgenologists give the chest field low voltage treatment, and treat axilla and supraclavicular space separately with high voltage.

There are a few roentgenologists who give an additional field from the back, expecting that this field will make up for the diminution of the intensity from the anterior field. This may be, from a theoretical

standpoint, the proper procedure, but only a surprisingly low percentage of radiation reaches the anterior chest wall. The benefit derived from this is not to be compared to the danger of damaging the lung tissue.

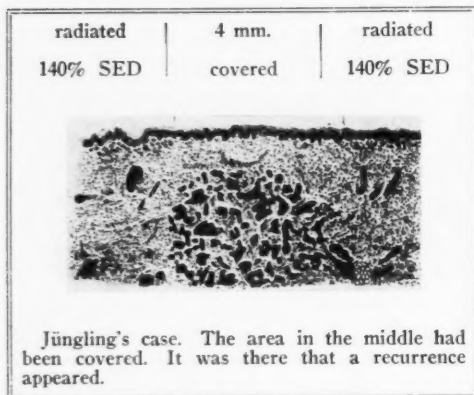


Fig. 2.

Both direct methods suffer from the disadvantage that the rays sweep through areas which are not at all affected by the disease, and which are highly sensitive to radiation. It must also be remembered that the blood circulates through these organs constantly, and will suffer from the effects of the radiation. If one compares the decrease of intensity in a beam created by high voltage, filtered through 0.5 mm. copper, and a beam created by low voltage, filtered through 4 mm. aluminum, one will find the difference comparatively small. The return to low voltage treatment, therefore, does not altogether mean that the danger of induration in lung and heart, and of general intoxication from the effects of the rays, is avoided. Furthermore, the chest wall in a normal person is from 4 to 6 centimeters thick, while that of a post-operative case is about 2 centimeters thick. As can be seen on the accompanying charts, the radiation from a field given anteriorly diminishes 34 per cent in a chest wall of 4 centimeters thickness before it reaches the lung when high voltage is used, and but slightly less in low voltage. Only the first 2 centimeters receive a satis-

factory percentage of radiation. A metastatic development of cancer within the mediastinum or the lung provides the only instance in which it is necessary to expose the entire chest diametrically to radiation.

To avoid all disadvantages, Holfelder and also Hintze and Finzi have endeavored to produce a homogeneous radiation of the chest wall by applying two tangential fields, one radiating from the sternum to the axilla, and the other from the axilla to the sternum. To Holfelder must be given great credit for developing the minute method, which has been adopted by most of the European clinics. In this country, Pfahler has already reported favorable results with this method. Holfelder uses 180 kilovolts, 0.8 mm. copper filter, and gives his treatments at 40 centimeters distance with a special 20×24 centimeter cone. The medial field is so directed toward the axilla that the furthest rays enter the chest at the sternum, and leave it in the anterior axillary line. The lateral field is directed toward the sternum, so that the farthest rays enter on the posterior axillary line and leave at the sternum. In this way only the chest wall, including the axilla together with a small part of lung and heart which lies anteriorly to the line drawn between mid-sternum and mid-axilla, will receive intensive radiation, while all other parts are spared. In order to improve the dose by scattered radiation, he builds up the chest wall by placing bags of rice over the body in the path of the tangentially applied beam. In persons with medium or large chests, Holfelder makes up the deficiency of the intensity between the two beams by applying a direct field over the mammillary line, and giving a small percentage of an erythema dose. When applying this field, he places shutters of lead foil in the cone within the path of the beam, the thickness of the shutters increasing toward the side of the field. By increasing or diminishing the distance of the shutters, the beam of

rays is adapted to the individual case. An additional supraclavicular field covers the distance between clavicle and ear.

Independently of the ideas of Holfelder, I have arrived at a method of using three tangential fields, instead of the two which Holfelder uses. Inasmuch as three beams centered at a certain point give a more homogeneous radiation, and also produce a greater depth intensity, I believe the three-field method is of advantage. Especially is this true in pre-operative and inoperable cases. The lateral field is applied to the axilla, being directed toward the sternum as in the Holfelder method. A second field enters below the breast, along the arch of the ribs, and is directed toward the axilla. The third field is applied over the upper part of the sternum, and radiates the angle between sternum and clavicle, being directed laterally and caudally. In very large chests, the intensity in the center is so small that it must be supplemented by an additional field from the front. This can be avoided by increasing the intensity of the three tangential fields, using a greater distance. As in the Holfelder method, the chest is built up with rice bags to increase the secondary radiation. If properly administered, the three-field method does not irradiate more tissue than the two-field method.

In order to investigate the true conditions, the author obtained a pair of lungs from an autopsy. They were inflated to their natural size immediately, and their vessels injected with quickly hardening gelatin. The author then prepared a paraffin phantom of the female chest, made true to living conditions, and in which the lungs fitted perfectly. At first the decrease of intensity of radiation in plates of paraffin over lung tissue was tested out, and the results charted. As the measurements were made with a 10×10 centimeter field, the values must be higher when using larger fields. The tables demonstrate that, as soon as the rays, travelling through paraffin, approach the lung tissue, their in-

tensity diminishes rapidly, until it becomes about 10 or 20 per cent less after reaching the lung than if the rays had travelled through paraffin alone. This applies to hard radiation as well as to soft. Once



Fig. 3. Small field technic without any system exposes patients to overdose and induration of deeper tissue and can lead only to haphazard improvements. (Observation of Lahm.)

having penetrated into lung tissue, the decrease in intensity then assumes a ratio similar to that in paraffin. Evidently the penetration through air-containing lung tissue is greater than through paraffin, and makes up for the partial loss of secondary radiation. Thus, with the chest wall 2 centimeters thick, the intensity of the rays at a depth 7 centimeters from the surface is 40 per cent when using high voltage, and 34 per cent when using low voltage. The charts also demonstrate that neither the high nor low voltage method of direct radiation produces a homogeneous distribution throughout the chest wall, at any given thickness. On the paraffin model, these experiments were repeated and found to be true. Both the two- and the three-field methods were tested out, and the values of each field measured at different points on the surface as well as between chest wall and

TABLE I.—DEPTH DOSES OF VARIOUS THICKNESSES OF PARAFFIN OVER LUNG TISSUE AT 180 K.V., 4 MA., 0.8 MM. CU FILTER, 40 CM. F.S.D., 10×10 CM. FIELD

| cm. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Paraffin Back-scattering |
|---------------|----|----|----|----|----|-----|-----|-----|--------------------------|
| Surface | 93 | 97 | 97 | 98 | 99 | 100 | 100 | 100 | 100 per cent |
| Depth, 1 cm. | | 90 | 94 | 97 | 98 | 99 | 100 | 100 | 101 per cent |
| Depth, 2 cm. | | | 82 | 85 | 89 | 91 | 93 | 94 | 94 per cent |
| Depth, 3 cm. | | | 71 | 73 | 77 | 81 | 82 | 84 | 86 per cent |
| Depth, 4 cm. | | | 62 | | 66 | 70 | 72 | 73 | 76 per cent |
| Depth, 5 cm. | | | 54 | | | 59 | 63 | 64 | 67 per cent |
| Depth, 6 cm. | | | 47 | | | | 51 | 53 | 58 per cent |
| Depth, 7 cm. | | | 40 | | | | | 44 | 52 per cent |
| Depth, 10 cm. | | | | | | | | | 36 per cent |

TABLE II.—DEPTH DOSES OF VARIOUS THICKNESSES OF PARAFFIN OVER LUNG TISSUE AT 130 K.V., 4 MA., 4 MM. AL FILTER, 40 CM. F.S.D., 10×10 CM. FIELD

| cm. | 0 | 1 | 2 | 3 | 4 | 5 | Paraffin Back-scattering |
|---------------|----|----|----|----|----|-----|--------------------------|
| Surface | 91 | 95 | 97 | 98 | 99 | 100 | 100 per cent |
| Depth, 1 cm. | | 86 | 93 | 96 | 98 | 99 | 101 per cent |
| Depth, 2 cm. | | | 77 | 86 | 88 | 90 | 92 per cent |
| Depth, 3 cm. | | | 66 | 71 | 77 | 79 | 81 per cent |
| Depth, 4 cm. | | | 56 | | 62 | 68 | 71 per cent |
| Depth, 5 cm. | | | 48 | | | 55 | 62 per cent |
| Depth, 6 cm. | | | 41 | | | | 54 per cent |
| Depth, 7 cm. | | | 34 | | | | 47 per cent |
| Depth, 10 cm. | | | | | | | 32 per cent |

lung. The measurements were all carried out with the Victoreen instrument, which proved to be highly satisfactory. It was surprising to find that, with the rice bags acting as secondary ray-producers, the intensity at two corresponding points of the chest (on the surface and in the depth) was almost the same, and that throughout the entire area, the distribution of rays was practically homogeneous. The reason why the chest received the same dose on the surface and

in the depth is that the beam in the tangential field is parallel with the curvature of the chest wall. In this respect, it differs from the direct method, which strikes vertically. In the tangential method, the two or three fields, respectively, supplement each other as to their intensity, and produce a homogeneous radiation far easier and better than the direct method, even if a posterior field is applied to overcome the defects in homogeneity.

In using the tangential method, the general tendency toward radiation sickness is far less: it is only occasionally that a patient complains of nausea. This, however, is due in part to the fact that the treatments are

number of leading radiologists here and abroad, the method of applying the total dose in one sitting has been entirely abandoned, and the treatments are spread over a period of from a few days to six weeks.



Fig. 4. (A) Areas radiated by Holfelder method, the rays entering on the black lines tangentially. (B) Extension of supraclavicular field. The larynx is protected by lead rubber. (C) Author's method using three fields tangentially, the rays entering at the black lines. The fields overlap, producing a perfectly homogeneous radiation of the entire area. (D) Cones for 30 and 40 cm. distances, as designed by Holfelder. The cone in the middle has one shutter inserted and the other shutter is placed outside. The shutters are used for the third supplementary field, to make up the deficiency in intensity of the two tangential fields in large chest diameters (Holfelder method).

no longer given in one or a few sittings. The full dose of each field is subdivided into two or three doses, which are given from one to three days apart. The diminution of the biologic effect through the loss of time is compensated for according to the Pfahler chart. At the end of the series, the patient will show a mild and even erythema over the entire area. According to a questionnaire which I sent out to a

Should a patient show, in the course of the treatments, that she is being too heavily taxed, the intervals between the treatments are increased to allow her to recuperate. I consider roentgen sickness as a severe symptom, which may contribute in lowering the resistance to the cancer. Schinz treats his inoperable and recurrent cases according to the Coutard method. Credit must be given to Pfahler for developing and standardizing

TABLE III.—SEX AND SOCIAL STATUS OF PATIENT, AND LOCATION OF TUMOR

| | Number of Cases | Per Cent |
|-----------------------|-----------------|----------|
| Males | 4 | 2 |
| Females | 206 | 98 |
| Married | 162 | 76 |
| Single | 48 | 24 |
| Right breast involved | 101 | 48 |
| Left breast involved | 96 | 45 |
| Both breasts involved | 13 | 13 |

TABLE IV.—SYMPTOMS WHICH FIRST ATTRACTED ATTENTION TO THE CONDITION

| Symptom | Number of Cases | Per Cent |
|---------|-----------------|----------|
| Tumor | 131 | 62 |
| Pain | 33 | 15.5 |
| Injury | 36 | 17 |
| Rash | 6 | 3 |
| Blood | 3 | 1.5 |
| Mole | 1 | .5 |
| Pimple | 1 | .5 |

TABLE V.—AGE INCIDENCE

| Years | Number of Cases | Per Cent |
|----------|-----------------|----------|
| 20 to 30 | 9 | 4 |
| 31 to 40 | 31 | 15 |
| 41 to 50 | 71 | 34 |
| 51 to 60 | 54 | 26 |
| 61 to 70 | 30 | 14.5 |
| 71 to 80 | 14 | 7 |
| 81 to 90 | 1 | .5 |

the method of saturation, which has helped considerably in improving the results.

In pre-operative cases, I try to finish the treatments within two weeks' time. As soon as the erythema has subsided, the patient is submitted to operation. The treatment does not render the subsequent opera-

tion more difficult or dangerous, as Jüngling has proven in a series of cases. The advantage lies in the fact that the growth and its periphery are rendered inactive, and even reduced in size. We are not attempting a general sterilization of the cancerous region as has been claimed by several authors, but are trying to inhibit the further growth and to gain time. Inasmuch as pre-operative treatment has its advantages, the social status, as well as the mental attitude of the patient should be taken into consideration. Aside from the additional expense, it may create false hope within the patient that an operation may be avoided. Some patients, seeing the good results obtained from radiotherapy, may refuse to return for the subsequent operation, thus depriving themselves of the advantage of the combined methods.

The advisability of sterilizing the ovaries at this time might be mentioned, to inhibit any further pregnancies. This has recently been again advocated by Wintz, and was, as early as 1896, suggested by Schinzing, who favored a combination of amputation of the breast with an operative sterilization. One cannot escape the impression that cancer grows more rapidly during pregnancy and lactation. Also, the removal of the ovaries acts beneficially on the resistance of the breast tissue, evidently by inner-secretory influence. I have had no experience in my own practice with this, but would suggest interruption of pregnancy in a case of cancer of the breast.

There is no haste in radiating a pre-operatively treated case after the operation has been performed, so long as the interval between the treatments does not exceed two months. However, the cases which had no pre-operative treatment should begin with post-operative treatments as soon as the general condition after operation permits, whether or not the wound has healed. Six to eight weeks after the last treatment, during which time the patient comes for regu-

TABLE VI

| Average time (in months) between | Primary operable, radiated | Primary operable, pre-oper. radiated | Primary inoperable, pre-oper. radiated | Post-oper. radiated | Recurrence | Inoperable |
|----------------------------------|----------------------------|--------------------------------------|--|---------------------|------------------|------------|
| first symptom and operation | — | — | — | 2 | 6 | — |
| first symptom and radiation | 2 | 2 | 6 | — | — | 13 |
| radiation and operation | — | 1 | 1 | — | — | — |
| operation and radiation | — | ½ | ½ | 1 | — | — |
| operation and recurrence | — | — | — | — | 20 (½ to 240) | — |
| recurrence and radiation | — | — | — | — | 5.5 | — |

TABLE VII.—TYPE OF OPERATION

| | Pre oper. | Post-oper. | Recurrent | Total | Per Cent |
|--------------------|-----------|------------|-----------|-------|----------|
| Radical | 12 | 30 | 62 | 104 | 71 |
| Simple | — | 3 | 40 | 43 | 29 |
| Total of all cases | | | | 147 | 70 |

lar examinations, a second series, smaller than the first one, is instituted. Three months hence, a third, still smaller, series usually finishes the course of the treatment.

While in the post-operative cases, we are able to follow a certain system, we must be guided entirely by the clinical symptoms and our own experience when we consider the treatment of inoperable or recurrent cases. The initial series is similar to that of the post-operative cases, except that the intervals between the treatments are shorter, and the doses higher. As quickly as the general resistance permits, the attempt is made to obtain a 100 per cent dose over the entire chest wall, including all regional lymph drainage systems which may be affected. In the inoperable cases, the three-field method shows its advantage, as the penetration of the three beams is better than that of two.

As soon as the erythema dose is reached, it is sustained for several weeks by smaller doses, according to the saturation method of Pfahler. Early in the course of the treatments, a regression of the cancerous tissue can be seen, so that in seven of the author's cases, which were quite far advanced, it was thought best to let the radical operation follow the x-ray treatment. Evidently this judgment was not correct, as all

TABLE VIII.—HISTOLOGY

| | |
|---|-----|
| Carcinoma..... | 76 |
| Adenocarcinoma..... | 37 |
| Medullary carcinoma..... | 21 |
| Scirrhus carcinoma..... | 33 |
| Paget's disease..... | 4 |
| Duct carcinoma..... | 4 |
| Alveolar carcinoma..... | 3 |
| Not obtained (cases were inoperable)..... | 32 |
| | 210 |

of these seven cases died of distant metastases before they had reached the five-year period. This fact, although the number of cases is small, seems to indicate that, in in-

method. It is not surprising to find that extensive bone lesions, as well as glandular involvement or metastases disseminated over the skin, respond well for a considerable

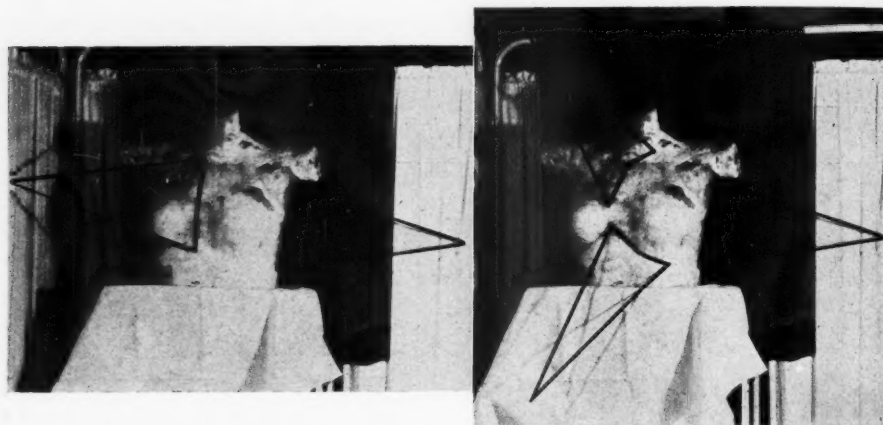


Fig. 5. (A) Direction of the rays in Holfelder (two-field) method, entering at the sternum and directed toward the left axilla coming slightly from right and front, at an angle of 30 degrees. The axillary field comes from left and posterior, being directed toward the sternum. The black lines represent the farthest rays of the beams nearest to the center of the patient. (B) Author's (three-field) method, dividing the sternal field of Holfelder in two, producing better depth intensity.

operable cases, even after good x-ray results, an operation is inadvisable.

The treatment of distant metastases must be adapted to the individual case, as well as to the individual location. The saturation method of Pfahler proves to be of advantage as it keeps the lesion under the influence of effective radiation, over a period of weeks. Some authors use the Coutard

time. Even spontaneous fractures will engage solid union. In advanced cases, the endeavor to give the patient palliation from pain and suffering is a great and noble, as well as satisfactory, undertaking. Many of these patients have suffered the most intense pain for months, and have found relief only by ever-increasing doses of morphine. They come to the radiotherapist in a condition of despair. Aside from the morphine medication, nothing has been done for them in a long time, which gives them the impression of hopeless illness. After a few treatments, sometimes even after the first one, the pain is alleviated, and the patient gathers new hope, as she sees that something is being done and results are beginning to show, by the decrease of her pain. Patients with metastases in the spine, as well as throughout the skeletal system, who have been bed-ridden for months, begin to eat again, and

TABLE IX.—METASTASES

| | Number of Cases | Per Cent |
|--------------|-----------------|----------|
| Bone | 22 | 29 |
| Lungs | 18 | 23 |
| Skin | 5 | 7 |
| Other breast | 4 | 5 |
| Liver | 1 | 1 |
| Generalized | 27 | 35 |
| Total | 77 | 100 |

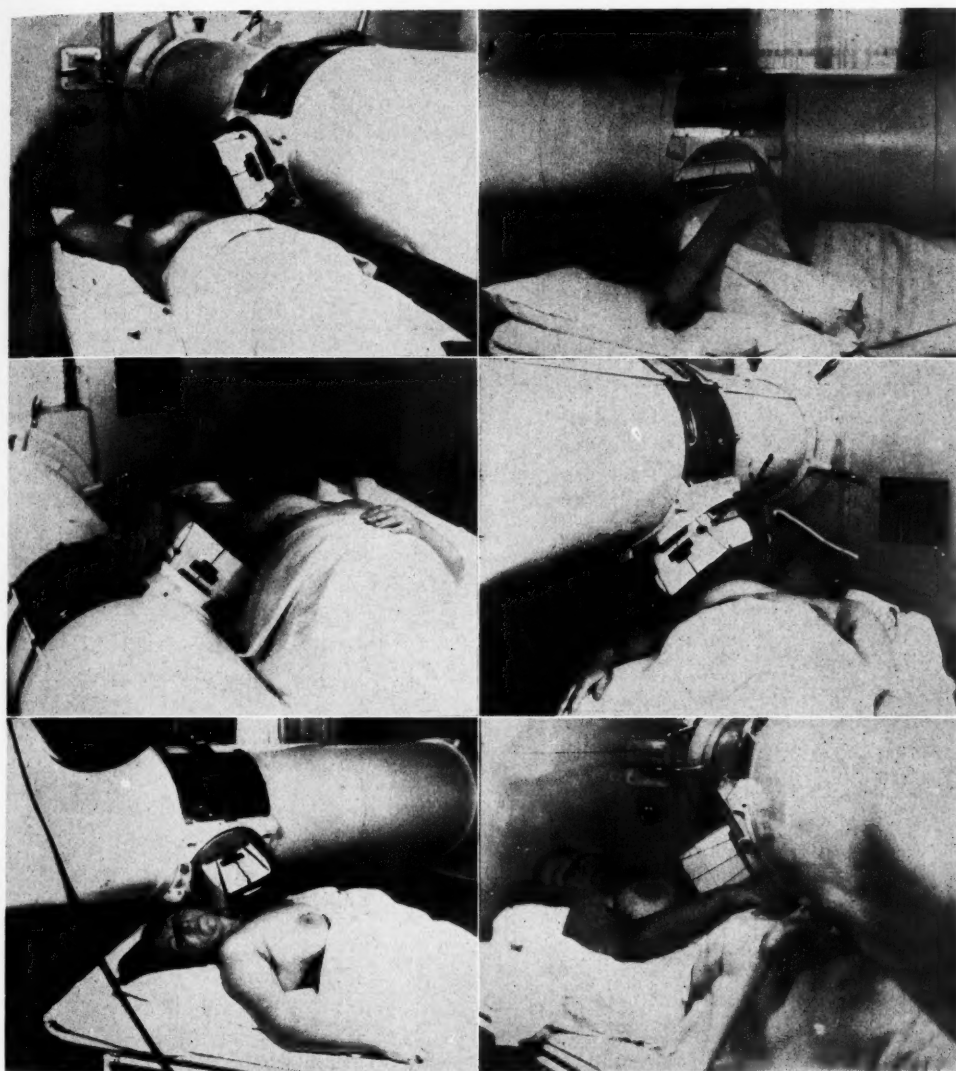


Fig. 6. (A and B) Sternal field of Holfelder method. (B) The chest is built up with bags of rice; between this and the patient's forearm is placed a sheet of lead rubber to prevent the escape of the rays which do not strike the body. All fields are given with the bags of rice upon the chest with the exception of (D) supplementary field. (C) Axillary field (Holfelder's and author's method). (D) Supplementary field (Holfelder's method). The shutters are indicated on one side by an arrow. (E) Supra-sternal field of the author. (F) Infra-sternal field of the author. These fields, too, are built up by rice bags.

not a few are able to leave their beds and walk around in comfort once more, be it only for a limited period.

In a few instances of our series, operation was considered contra-indicated for various reasons, though the growth was

operable. Certain tendencies toward exclusive radiotherapy of carcinoma of the breast are well known, but such considerations are beyond the scope of this paper.

During the period from 1923 through 1930, 210 cases were treated with roentgen

TABLE X.—RESULTS

| Group | Total | Well over 3 years | | Well over 5 years | |
|--------------------------------------|-------|-------------------|------|-------------------|------|
| I. Pre-operative—post-operative | | | | | |
| A. operable | 7 | 6 of 7 | 86% | 3 of 4 | 75% |
| B. inoperable | 5 | 1 of 5 | 20% | 0 of 5 | 0% |
| Total | 12 | 7 of 12 | 58% | 3 of 9 | 33% |
| II. Post-operative—prophylactic | 33 | 28 of 33 | 85% | 10 of 13 | 78% |
| III. Post-operative recurrent | 102 | 34 of 102 | 33% | 11 of 48 | 23% |
| IV. Inoperable cases | 58 | 34 of 58 | 59% | 13 of 36 | 36% |
| V. Primary operable, not operated on | 5 | 5 of 5 | 100% | 4 of 4 | 100% |
| Total | 210 | 108 of 210 | 52% | 41 of 110 | 37% |

rays, for various conditions of malignancies of the breast, either at my private institution or at the Metcalf Foundation. In 1923, the direct method was used on a few cases, all others being treated by the tangential method, using, for the most part, the three-field technic. The kilovoltage used was 180, generated either by a mechanically rectifying or kenetron tube machine, using a 0.5 or 0.8 mm. copper filtration. The average time which elapsed between the appearance of the first symptom and the operation or radiation can be seen by referring to Table IV, which obviously presents the fact that the longer the time between appearance of the first symptom and operation or radiation, the more are the patients exposed to recurrences and metastases or inoperability. In some cases, they have hidden their condition for two or three years before going for proper treatment. In about 10 per cent of the inoperable cases, it could be assumed that rough manipulation and squeezing, massage and rubbing (sometimes upon advice) may have been conducive to the spread of the disease, and thus the death of the patient. On the other hand, biopsies, if done carefully, apparently will not further the spread of the disease. I prefer the cauter knife, to avoid direct

implantation of living cancer cells. More than half the patients in the author's series (62 per cent) visited their physician upon noticing the tumor. Of the 210, 16 per cent had pain as their first symptom, and 17 per cent could refer to an injury previously received. The remainder (5 per cent) noticed either blood, a mole, a pimple, or a rash around the nipple. Seventy-one (34 per cent) were between the ages of 41 and 50; 25 per cent were between 31 and 40.

In the histologic classification, six different types of cancer are represented: the others are pronounced without further detail to be cancer. If a specimen was not obtained, the case was obviously inoperable, and did not leave any doubt as to the diagnosis. Of the five early cases, which received only x-ray treatment, one did not have a microscopic diagnosis but was pronounced cancer by several surgeons. Of the inoperable and recurrent cases, 77 had symptoms of metastasis (29 per cent to bone, 7 per cent to skin, 23 per cent to lungs, 5 per cent to the other breast, 1 per cent to the liver, and generalized metastasis, 35 per cent). Most recurrences occurred in the first few months. Of the 210 cases, 147 were operated on. Of these, 104 received a radical Halstead, and 43, a simple mastec-

tomy. It is interesting to note that the ratio of partial operations is highest in the group of recurrent cases. The longest period between operation and recurrence was 18 years. The five cases which were primarily operable, had, as contra-indications to the operation, heart disease in four cases, and kidney disease in one. In the statistics, the cases which were not heard from again, are registered as "dead" from the time of the last communication. Of the cases marked "dead," 10 died of intercurrent diseases, and did not show any symptoms from their cancer at the time of death.

Pfahler, in his report on results of radiation therapy in 1,002 cases, has shown the superiority of the combined method of operation with irradiation in the cases with and without involvement in the glands. His percentage of three- and five-year end-results range with the best ever obtained, and bespeak the superiority of the tangential method. His results are, in the pre-operative group, as follows: 62 per cent in 3 years, 50 per cent in 5 years; in post-operative cases, 63 per cent in 3-year results, and 55 per cent in the 5-year; in the recurrent cases, 37 per cent in the 3-year results, and 17 per cent in the 5-year; in inoperable cases, 42 per cent in the 3-year, and 30 per cent in the 5-year; in primarily operable

cases, 88 per cent in 3-year, and 82 per cent in the 5-year results, with a grand total of 50 per cent in 3-year, and 36 per cent in 5-year cases.

In my report, I have not subdivided the groups as Pfahler has done, as the number of my cases is too small to express the subdivisions in percentages. However, comparison of my statistics with his shows a similarity gratifying to me. I also refer to the articles of Pfahler and Portmann for references to the literature and comparative figures.

CONCLUSIONS

It appears that a combination of radiation and operation offers, at present, the best results in the treatment of carcinoma of the breast.

The tangential method of irradiation, with the two-field (Holfelder's) method, or three-field (author's) method, has considerable advantage over the direct methods.

Although a greater uniformity and standardization of the different methods of treatment is to be desired, it must be remembered that, in order to obtain the best results, each case must be studied individually, and only long experience and diligence will lead the way to accomplishment.

PLEURAL CALCIFICATION

CALCIFICATION OF THE ENTIRE PARIETAL PLEURA, WITH REPORT OF A CASE

By HAROLD A. HILL, M.D., NEW HAVEN, CONNECTICUT

CALCIFICATION of localized patches of pleura is not uncommon and a number of cases have been reported. Calcification of the entire parietal pleura, with the co-existence of a lesion partially destroying three ribs and three vertebrae, constitutes a sufficiently rare pathologic and roentgenologic picture to warrant a report.

CASE REPORT

A. R., aged 62 years, white, female, entered the surgical service of the University of California Hospital in July, 1931, complaining of marked dyspnea, paralysis of both legs, and loss of sphincter control. The family and past history contribute nothing of value.

Present Illness.—About fifteen years ago

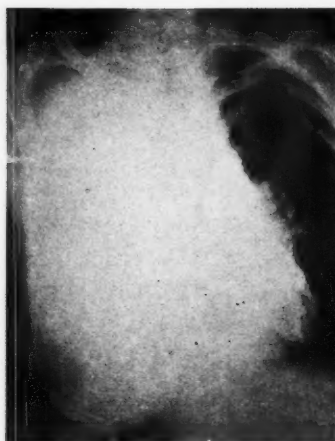


Fig. 1. Postero-anterior view with usual lung technic. (See text.)

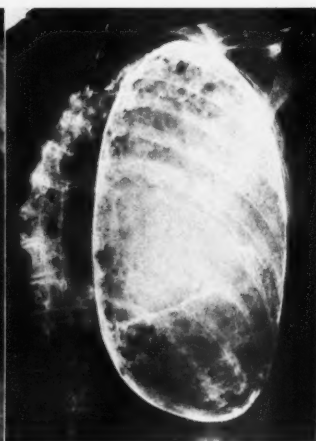


Fig. 2. Postero-anterior view with spine technic. This shows the marked pleural calcification and the changes in the ribs and vertebrae.



Fig. 3. Lateral view with spine technic, demonstrating the "football-shaped" outline of the calcified pleura.

while working in a laundry the patient was attacked suddenly with severe dyspnea. She was unable to work for four months, during which time she had orthopnea and moderate ankle edema. After returning to work she had no complaints for the ensuing eight years. She was unable to recall the manner or time of onset of her present dyspnea. She has never been troubled with cough, hemoptysis, or chest pain.

In 1924 she became aware of hypoesthesia in both feet, which gradually progressed upward. Since 1925 she has been a complete invalid due to a spastic paralysis of both legs, accompanied by weakness of the abdominal muscles and complete anesthesia up to the umbilicus. She began to lose sphincter control early in 1926. There has been little progression of her symptoms during the last five years.

Physical examination disclosed an old, emaciated woman, propped up in bed and markedly dyspneic. The thorax was emphysematous and asymmetrical, with a marked fullness on the left side. On this side expansion and fremitus were absent, percussion was flat, and the breath sounds were inaudible. The right side gave the usual signs of emphysema. The heart was displaced to the right.

On the left side posteriorly there was a compressible, non-tender swelling extending from the level of the sixth to the twelfth dorsal vertebra. There was a marked kyphos of the dorsal spine and a marked scoliosis to the right around the above-mentioned mass.

Neurologic examination revealed a complete spastic paralysis of both legs, partial paralysis of the abdominal muscles, complete anesthesia from the tenth dorsal segment downward, complete loss of bladder and rectal control, absent abdominal and left Achilles reflexes, and a bilateral positive Babinski.

The blood, urine, and spinal fluid examinations, including blood and spinal fluid Wassermann tests, were negative.

Roentgenologic examination with the usual lung technic revealed a dense, sharply outlined shadow obliterating almost the entire left lung field, with displacement of the heart to the right (Fig. 1). Films made with a more penetrating technic showed the density of the left half of the chest to be due to a large, oval, heavily calcified shell showing no internal structure whatever (Fig. 2). The left eighth, ninth, and tenth ribs appeared to be destroyed for a distance of three or four inches lateral to the spine. The left seventh and eleventh ribs showed pressure defects on their lower

and upper edges, respectively. The left halves of the eighth, ninth, and tenth dorsal vertebral bodies, pedicles and laminae, were seen to be destroyed. The spine was angled to the right at this level (Fig. 3).

These findings somewhat suggest an old, rather unusual Pott's disease of the dorsal spine, with partial necrosis of three ribs and an extensive calcification of the pleura. The ragged appearance of the edges of the destroyed bones, together with the peripheral type of calcification of the involved pleura, was considered as best to be explained by a diagnosis of a tuberculous lesion. One roentgenologist considered it as a chondroma arising from a rib and destroying other ribs and vertebrae by pressure. The possibility of a calcified endothelioma was also considered.

A dorsal laminectomy, with decompression, was done by Dr. H. Fleming on July 16, 1931. The operator saw what he thought to be tumor tissue surrounding but not involving the spinal cord and connected with the large tumor in the left chest. He decompressed the spinal cord but did not attempt to remove the tumor. The patient made an uneventful recovery from her operation but died on Aug. 30, 1931, from what was clinically diagnosed as a hypostatic bronchopneumonia of the right side.

An autopsy, performed by Dr. L. W. Buck, showed congestion, edema, and bronchopneumonia of the right lung. The entire left parietal pleura was thickened to from 1 to 2 cm., and so calcified that on removal it resembled a large football. The calcified mass was closely adherent to the eighth, ninth, and tenth ribs, whose posterior two or three inches had been destroyed, and to the eighth, ninth, and tenth dorsal vertebrae, which had been almost entirely eaten away by the necrosing process. The calcified shell contained about a thousand c.c. of serous fluid and a small fibrous mass which represented the left lung. It was about 6x3 cm. and consisted of a few remnants of lung tissue and hyalinized scar tissue. This mass was covered by thickened pleura but it had not been calcified. At the level of the destroyed vertebrae there was a scoliosis of the spine to the right, causing compression of the cord, which was further

encroached upon by the diseased meninges, the latter being markedly thickened by an inflammatory fibrosis. The appearance of the entire lesion suggested an old tuberculous process. A guinea pig inoculated with the contents of the calcified shell developed tuberculosis.

REVIEW OF THE LITERATURE

Pleural calcification has been recognized and reported since the middle of the eighteenth century, when Morgagni and other early anatomists discovered this condition during the course of various necropsies (8). From that time until the beginning of the last decade approximately fifty cases were reported, a number of them being reviewed by Tuffier in 1907 (30). Since 1922, however, at least double the foregoing number, or about a hundred cases, have been reported by approximately thirty authors. Several more or less complete discussions of the subject of pleural calcification have been published (3, 5, 8, 17, 23, 25, 30, 32). No important contribution concerning this topic has appeared in the American roentgenologic literature.

Practically all of the cases reported prior to 1920 were discovered at postmortem examinations. Pleural calcification has been disclosed much more frequently, especially in the living, during the last decade, because of the following three factors:

- (1) The marked advances made in the field of roentgenology;
- (2) the increasing frequency of surgical intervention in abnormal thoracic conditions;
- (3) the increased incidence as a result of chest injuries sustained during the late World War.

INCIDENCE

The recorded incidence of pleural calcification varies with the type of material examined and the kind of examination. It is naturally higher when the basis of calculation is the number of roentgenologic chest examinations, than when it is the total num-

ber of chests examined, some with and some without the help of the x-ray. Behrendt (3), working with war veterans who had either received gunshot injuries to the chest or who had acquired a pleurisy from undue exposure plus fatigue, reported 11 in 886 cases fluoroscopically examined, or 1.2 per cent. In 1,845 chest examinations, Ulrich (31) found 16 cases, or 0.87 per cent. Included in his series, however, were five cases of gunshot wounds of the chest. The incidence when based upon the number of chest examinations in a general clinic is about 0.2 per cent, as the following figures show: Pritchard (25), eight cases in 7,000 examinations, or 0.12 per cent; Velde (33), eight cases in 4,500 examinations, or 0.18 per cent; Oldenburg (23), six cases in 3,000 examinations, or 0.2 per cent, and Lippmann (22), three cases in 1,660 examinations, or 0.18 per cent.

In the cases so far reported about two-thirds have occurred in men. Salter (26) reported a case in a six-year-old boy; Goullioud (10) in a patient of 81. The average age when a diagnosis was made at necropsy was considerably greater than it has been since roentgenology and surgery have made the diagnosis possible in the living. At present 40 is the average age when the condition is discovered. As a corollary, the interval between the onset of a pleural disorder and the observation of calcification has been reduced. Levijveld (21), when operating on a pyopneumothorax four months after pneumonia, found the walls of a sacculated pleural empyema studded with calcified plaques. The majority of investigators have found the interval to vary in most cases between ten and twenty years. In this respect, the present case is found at the mean, or fifteen years.

ETIOLOGY

There has been considerable controversy as to the part played by tuberculosis in the origin of pleural calcification. Pritchard

(25) states that, "the clinical history of the case suggests that most of the pleural calcifications are probably not due to the action of tubercle bacilli." This opinion has been held by several other authors (5, 6, 11, 21, 27). Still others (20, 31, 32) have stated that tuberculosis, as a cause for the deposition of calcium salts on the pleura, is of only minor importance. However, several recent authors, who have made some of the more important contributions to the literature of this topic (3, 8, 17, 23), have been very emphatic in stating that tuberculosis is an important etiologic agent.

In 126 reported cases, mention has been made of a proven or probable causative factor. In 24 of these, tuberculosis was definitely diagnosed either by sputum examination, positive roentgenologic evidence, or by necropsy. A tentative diagnosis of tuberculosis was made but not proven in 10 other cases.

Twenty-eight cases, about one-fourth of the total number of reported cases, were secondary to a traumatic hemothorax, due to a gunshot or stab wound in the chest. These reports, however, have been published almost exclusively within the last four years (3, 8, 9, 17, 20, 25, 31, 33 have published 5, 1, 2, 5, 4, 1, 5, and 2 cases, respectively).

In a relatively large number of the remainder of the reported cases, no history of any preceding pulmonic or pleural illness was elicited. In others, it was found that there had occurred in the preceding years a pleurisy or an empyema, the latter frequently the result of a pneumonia. It seems likely that tuberculosis has been the main etiologic factor in many other cases in which this diagnosis has not been proven, due to the difficulty of establishing the cause by ordinary methods. In confirmation of this opinion, the problem of the present case is offered. Although tuberculosis was suggested as the probable cause, from the roentgenologic appearance of the spine, the opera-

tive findings were opposed to this, and the presence of tubercle bacilli was proven only after the inoculation of a guinea pig with contents of the pleural cavity.

EVOLUTION OF LESION

The process whereby calcium salts are deposited on, or in, the pleura has been thoroughly discussed (3, 5, 6, 12, 17, 32, 33). There are still several controversial points, such as the effect of an altered blood supply, or blood chemistry (2, 3, 12, 25), or the possibility of an endocrine factor (32). Nevertheless, there is a general agreement on the main points of the process. The presence in the pleural cavity of some sanguineous or infectious irritant causes the vitality of a small or large area of the pleura to be lowered. This results in a deficient metabolism of the involved tissues. The center of the mal-nourished or necrotic area becomes poor in cellular elements and vessels, but rich in collagenic fibers. As this process spreads out from the center the fibrous tissues, by hyaline degeneration, assume the characteristics of a tissue physically analogous to cartilage. It is in this tissue that the deposition of calcium salts occurs—the process rarely goes on to form true osseous tissue.

Microscopic study of sections of tissue from the pleura of the case herewith reported illustrates well the different stages in the formation of pleural calcification. It shows scattered throughout an edematous, fibrous tissue numerous spherical bluish-gray bodies of from 2 to 30 micra, surrounded by hyalinized areas of variable extent.

EXTENT OF LESIONS

The calcium deposits take variable gross forms, from that of a small spot to a shell enclosing the entire lung. Several cases of the latter have been reported (3, 8, 21, 25, 30, 31), but the process has been less marked than in the present case, in which the aver-

age thickness of the calcified pleura was 2 centimeters.

Accompanying the pleural calcification there have been four cases reported in which the lung was markedly compressed and carinified (15, 26, 28, 34). As in the present case, this discovery was made at autopsy. Hammer (11) reported a case with tuberculous caries of the third and fourth vertebrae and an extensive tuberculous involvement of the lung. Unlike the case here reported, however, there were only a few small calcified pleural shadows present. The third and fourth ribs were partially necrosed in a case reported by Sweet (29) but there was no involvement of the vertebrae and the calcification was not as marked as that found in the case herewith reported.

CLINICAL FINDINGS

The complaints of the patient have always been comparable to the extent of the lesion; accordingly, the majority have had neither symptoms nor signs at the time the presence of calcification was discovered. With an extensive process the patients presented the usual respiratory triad of dyspnea, cough, and pain. The physical findings in the more extensive cases have been an asymmetrical thorax, displacement of the mediastinal contents, immobility on the affected side, a dull or flat percussion note, and diminished or absent breath sounds. In other words, the clinical picture is that which is frequently found with a large pleural effusion, a massive consolidation, or a large pulmonary or pleural tumor or cyst.

ROENTGENOLOGIC FINDINGS

Due to the advancements made in the practice of roentgenology in the past few years, the discovery in the living of pleural calcification has become increasingly more frequent. The findings on a roentgenologic study depend upon the extent of the pathologic process present. The deeply opaque shadows due to the calcification of the

pleura have been rather arbitrarily divided on the basis of size into the following three groups:

(a) Platelets or spots from 1 mm. to 2 cm. in diameter, usually multiple and irregularly distributed over a small or large portion of the pleura.

(b) Plaques, almost always single, most frequently found in the posterior inferior thorax as circular shadows with a sharp, uneven border or as an irregular rectangular shadow with its vertical axis parallel to or coincident with the posterior axillary line.

(c) Shells, formed by the calcification of the entire pleura or the walls of a large hematoma or encapsulated empyema.

Calcification of the interlobar pleura is quite rare, having been reported in but two instances (1, 8). Likewise, calcification of other portions of the visceral pleura is most unusual.

Fluoroscopic examination in the different planes of the thorax has been of considerable value in making a diagnosis, especially in those cases in which the calcified areas were relatively small. It should be emphasized that not infrequently the presence of calcification will not be suspected unless roentgenograms are made with an exposure at least as penetrating as that used for the dorsal vertebrae. This was proven in the present case, in which the films made to show the lung markings suggested the presence of a large pleural effusion, whereas those made with a technic to show the dorsal spine revealed the calcification of the pleura.

DIFFERENTIAL DIAGNOSIS

The history and physical findings are not diagnostic; therefore, accurate roentgenologic interpretation gives the greatest hope for the proper diagnosis of this condition during the life of the patient.

Pleural calcification in the form of small specks or spots must be distinguished from pneumoconiosis, from calcification occurring in tuberculous lesions of the lungs and

in tumors, and from Virchow's "calcium metastases." All of these are within the lung proper—deep to the pleura. The knowledge that pleural calcification is rarely of bilateral distribution is extremely helpful in making the differentiation.

Plaques of moderate size and small shells may be confused with a calcified tuberculous cavity, an echinococcus or dermoid cyst or cysts, and with calcified portions of pulmonary or pleural tumors. In reaching a diagnosis when the entire parietal pleura is calcified, one has to exclude a large pleural effusion, an acute or chronic inflammatory process involving all of one lung, a huge bronchogenic tumor, a chondroma (13, 14), or a large pleural tumor such as an endothelioma (16). Freeman (7) reported a diffuse endothelioma involving the entire pleura, with necrosis of several ribs and a clinical picture simulating a spinal cord tumor. The presence of a calcified pleura in the present case, which in several other respects was identical with the case Freeman reported, was of diagnostic significance since pleural endotheliomas are rarely calcified.

If one thinks of the possibility of pleural calcification, a correlation of the history and physical findings with the roentgenologic evidence will make the differential diagnosis comparatively simple in most instances. However, it would be impossible to distinguish between an extensive pleural calcification, such as was found in the present case, and the calcification of a huge lung cavity. Though cases with cavities occupying all of one lung are extremely rare, reports of such are to be found in the literature (4, 18, 24).

The attempts to remove calcified pleural plaques have been infrequent (8, 10, 21, 27, 29, 30). The question of their resection in the future is one for the thoracic surgeons, as is also that of the use of thoracoscopy to obtain confirmatory evidence of their presence.

The author desires to express his thanks to Dr. H. E. Ruggles and Dr. R. S. Stone for their encouragement and help in the preparation of this report.

SUMMARY

The clinical, roentgenologic, and pathologic findings of an interesting case of calcification of the entire left parietal pleura are presented.

From the literature it is shown that the incidence of pleural calcification is about 0.2 per cent. The etiologic factors are tuberculosis, hemothorax, pleurisy, and empyema. The average time between the original illness and the finding of the calcification is fifteen years.

The roentgenologic differential diagnosis is discussed.

The importance of films with a more penetrating technic than is usual for the lung is emphasized.

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THE EFFECT OF X-RAYS ON THE VITAMIN B CONTENT OF WHEAT SEEDLINGS

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RECENTLY Cattell (1) demonstrated that wheat seedlings were relatively sensitive to the action of x-rays and that less than a threshold erythema dose reduced the growth of the roots to half the normal length. This raised the question as to whether this action of the x-rays might not be due to the destruction or alteration of certain chemical substances within the seeds essential to plant growth.

As a preliminary study, we have determined the extent of the injurious action of x-rays on the growth-promoting Vitamin B of the wheat seeds. Because of the occurrence of Vitamin B in relatively large amounts in seed embryos it would seem likely that this vitamin plays a part in the normal growth of the plant; but whether it is equally essential to the life of the chlorophyll-bearing plants as to that of animals is not yet well established.

Experimental Procedure.—In dealing with a substance as rich in Vitamin B as wheat seeds it was necessary to take certain precautions to guard against error in the interpretation of results. Thus it was quite possible that although a considerable percentage of the vitamin may have been destroyed by the x-rays, a sufficient amount remained uninjured to provide normal growth when an excess of the wheat was added to the diet of the experimental animals. We have, therefore, included a determination of the minimal wheat seed content in the diet necessary for normal growth.

Young albino rats, about 28 days old, were fed upon our incomplete synthetic diet (2) consisting of casein 22, starch 43, cane sugar 10, agar-agar 2, butter fat 20, and salt mixture 3 per cent for from two to three

weeks in order to establish an equilibrium in body weight. Distilled water was given *ad libitum* in every case. When the animals became unable to grow or nearly so, on this diet, they were changed to a ration containing 3, 6, or 9 per cent of powdered wheat seeds, the amount of seeds replacing an equivalent amount of starch in the diet. Individual animals consumed about four grams of the ration daily. The wheat seeds we used during the 1930-1931 experiments were obtained from the South Dakota Agricultural Experimental Station. The variety is known as "Kota," No. 1184, 1927 Crop.

The results of these experiments indicated that 6 per cent of wheat seed content in our purified artificial diet seemed to be sufficient to promote normal growth in young albino rats during the experimental periods of from 30 to 60 days. The failure of some individual animals to maintain the normal rate of growth was partly due to a difference in their own Vitamin B requirement and not to possible toxic substances present in the wheat seeds. The average daily gain in body weight of 15 young rats (three sets of experiments) was from 0.62 to 2.4 grams. This figure of average daily gain was nearly identical with that obtained from feeding young rats with a purified artificial diet containing 2 per cent of brewer's yeast as a source of growth-promoting Vitamin B (2). From the comparison, one may conclude that wheat seed is not as rich a source of Vitamin B as yeast.

Action of X-rays on Dry Wheat Seeds.—About fifty grams of dry wheat seeds were placed in a large Petri dish (diameter, 13 cm.) and subjected to the radiation from a standard water-cooled Coolidge x-ray tube under the following conditions: 200 K.V.,

10 ma., no filter, time of exposure four 2.5-hour periods within one day, a distance of 43 cm. from the target. Under these conditions the seeds received a total of about 120,000 roentgens.

was 0.84 gram, while those fed upon a synthetic diet containing 6 per cent of non-irradiated wheat seeds showed the average daily gain of 1.53 grams. This indicated that the heavy doses of x-rays had a dis-

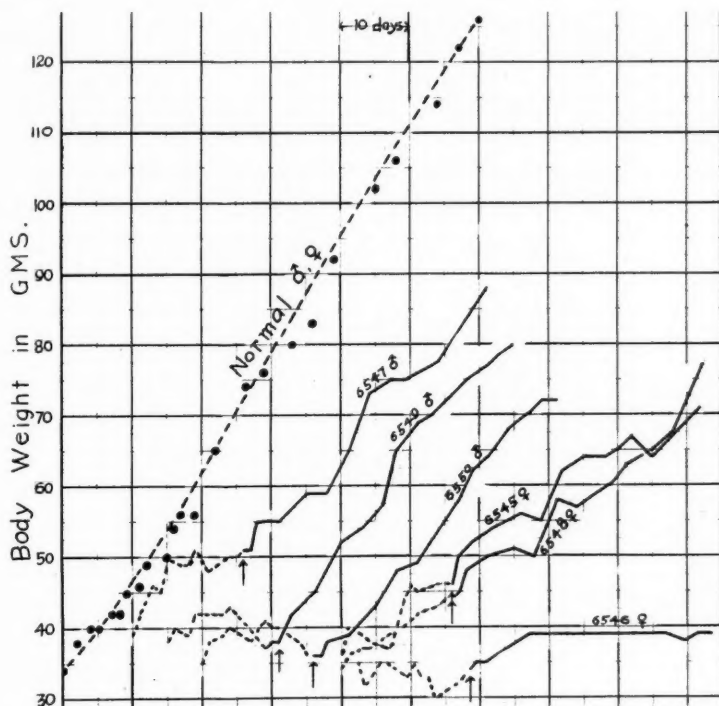


Chart I. Curves showing the retarded growth of young albino rats fed upon a synthetic diet, consisting of casein 22, starch 43, cane sugar 10, agar-agar 2, butter fat 20, salt mixture 3, and irradiated wheat seeds, 6 per cent. At the point marked by the arrow (↑) a Vitamin B-deficient diet was changed to the above diet.

The broken line indicates the average growth curve of rats fed on a synthetic diet containing 6 per cent of non-irradiated wheat seeds as a source of Vitamin B.

When the young rats became unable to grow after being restricted to a diet deficient in Vitamin B they were fed with a ration containing 6 per cent of the powdered irradiated wheat seeds, the feeding being continued for a period of 35 days. The results obtained from this experiment are shown in Chart I.

It is evident that the young rats were able to grow but that the rate of growth was retarded. The average daily body growth

was 0.84 gram, while those fed upon a synthetic diet containing 6 per cent of non-irradiated wheat seeds showed the average daily gain of 1.53 grams. This indicated that the heavy doses of x-rays had a dis-

tinctly injurious action upon the growth-promoting Vitamin B in wheat seeds. It is interesting to note that when these irradiated seeds were planted in soil in pots and kept on the roof during a warm month (June, 1930), they grew only about 2.5 cm. in height in two weeks, while the control seeds grew about 15.2 centimeters. In the irradiated seeds, the sheath was quite pithy compared with the controls. There was a marked inhibition of growth as to the size

of plant developing from the irradiated wheat seeds, but the quantity of x-rays used was still insufficient to prevent germination and some subsequent growth.

We repeated these experiments with another batch of irradiated dry wheat seeds, prepared under physical conditions similar to those of the preceding experiment. Young rats, 30 days old, were first maintained on our incomplete synthetic diet for 14 days, after which those rats which had ceased to grow, or nearly so, were transferred to another ration, similar, but containing 6 per cent of irradiated seeds. The results of this experiment are given in Table I.

TABLE I.—RESULTS OF FEEDING RATS WITH A SYNTHETIC DIET CONTAINING 6 PER CENT OF IRRADIATED WHEAT SEEDS AS A SOURCE OF VITAMIN B

| Rat No. | Initial body weight (gm.) | Final body weight (gm.) | Average daily body growth (gm.) |
|---------|---------------------------|-------------------------|---------------------------------|
| 6580 ♂ | 42 | 80 | 0.95 |
| 6581 ♂ | 40 | 89 | 1.22 |
| 6582 ♂ | 42 | 75 | 0.82 |
| 6583 ♂ | 46 | 52 | 0.15 |
| 6584 ♀ | 38 | 79 | 1.02 |
| 6585 ♀ | 39 | 77 | 0.95 |
| Average | | | 0.85 |

The above data showed that young rats fed on the synthetic diet containing the irradiated wheat seeds grew at about half of the normal rate during the experimental period of 40 days.

Action of X-rays on Wheat Embryos.—It is now known that wheat embryos are particularly rich in the growth-promoting Vitamin B. The outer seed coats contain much less of this important food factor, while the endosperm contains an extremely small amount of it. Like enzymes, the vitamins are more sensitive to physical agents, such as heat and ultra-violet radiation, when wet than when dry. If this assumption holds true for the other types of physical

agents, we may expect to obtain a much higher percentage of Vitamin B destruction by irradiating the wet seeds with x-rays, i.e., not only "wet" but physiologically active—"growing" instead of in the resting state.

As in the case of the preceding experiments, we first determined the approximate minimum wheat embryo content necessary for normal growth of young albino rats. The dry seeds were carefully washed in distilled water and left soaking in it for 3.5 hours at from 25 to 26° C. Then they were planted in large moist chambers, with moist filter paper at the bottom, where they were allowed to germinate 24 hours in the dark at from 25 to 26° C. At the end of this period the newly germinated embryonic tissues (germ, sheath, shoot, and roots)¹ were separated from the swollen seeds with small forceps. These wheat embryos were dried at room temperature in a vacuum desiccator containing CaCl₂-NaOH for about four days. The dried embryos were then pulverized in a mortar and kept in a closed bottle until used.

Young rats were placed on the Vitamin B-deficient diet mentioned before, and, when their body growth ceased, or nearly so, they were fed on a synthetic diet containing 0.5, 1.0, 2.0, or 3.0 per cent of pulverized wheat embryos. The results of these feeding experiments showed that 1 per cent of wheat embryo content in the synthetic diet was sufficient to promote normal growth in young animals. The average daily gain in body weight of 10 young male rats (2 sets of experiments) on a ration containing 1.0 per cent of wheat embryo was 1.76 grams (Chart II).

In preparing an experiment with irradiated wheat embryos, the following general technic was employed. Wet seeds were allowed to germinate as before and subjected to the radiation from a standard water-cooled Coolidge x-ray tube under the

¹For convenience, they are designated in the present paper as "wheat embryos."

following conditions: 200 K.V., 30 ma., no filter, 43 cm. distance, and 2 hours' exposure. Under these conditions the seedlings received a total of about 60,000 roentgens. Then the embryos were dissected

represents the normal growth curve of young rats fed with a synthetic diet containing 1 per cent of non-irradiated wheat embryos.

It is evident from the results shown in

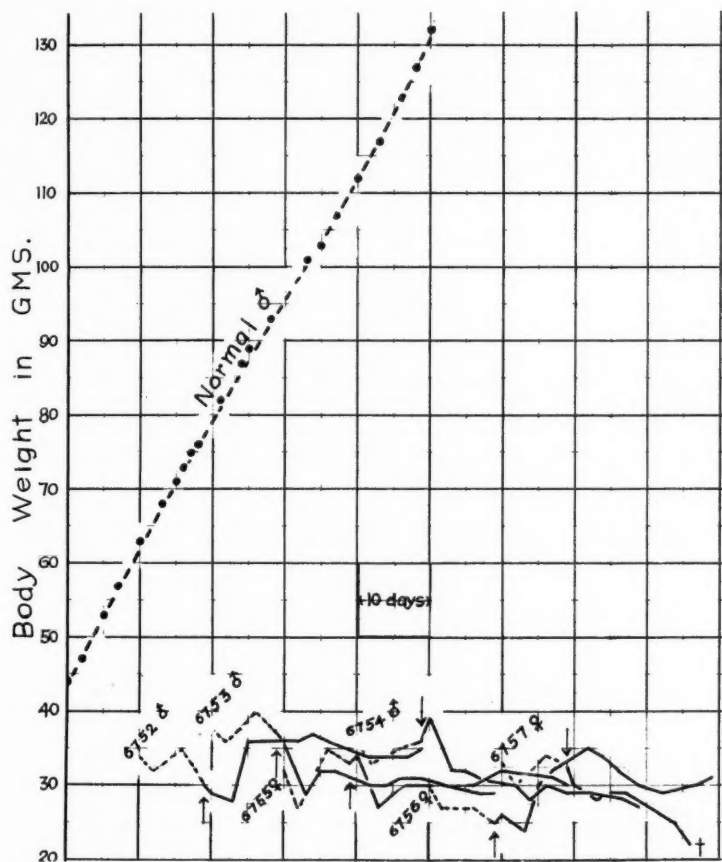


Chart II. The continuous lines represent the growth curves of young albino rats fed upon a synthetic diet containing 1 per cent of the irradiated wheat embryos as only source of Vitamin B. Note that growth ceases on this ration, but the animals remain at about the same weight for extended periods.

The broken line is a curve of normal growth of male rats fed on a synthetic diet containing 1 per cent of non-irradiated wheat embryos.

from the seeds within a few hours after irradiation and dehydrated as before.

Preliminary feeding experiments with young rats indicated that a synthetic diet containing 1 per cent of the irradiated wheat embryos as the only source of Vitamin B failed to induce growth in these animals (Chart II). The broken line in Chart II

Chart II that the growth-promoting Vitamin B in wheat embryos was almost completely destroyed by the heavy doses of x-rays. As in the case of the irradiated dry seeds, when these irradiated wet germinated seeds were planted in soil in pots and kept on the roof during a warm month (June, 1930), they grew about 4.5 cm. in height in

two weeks. On the other hand, the control seeds in the same period of time grew about 16.5 cm. in height. The young plants from the control seedlings continued growth and developed foliage, but those from the irra-

edly affected but not completely destroyed by the amount of x-radiation administered. Upon this ration, the growth of animals was about one-fifth of the normal rate during the experimental period of 21 days.

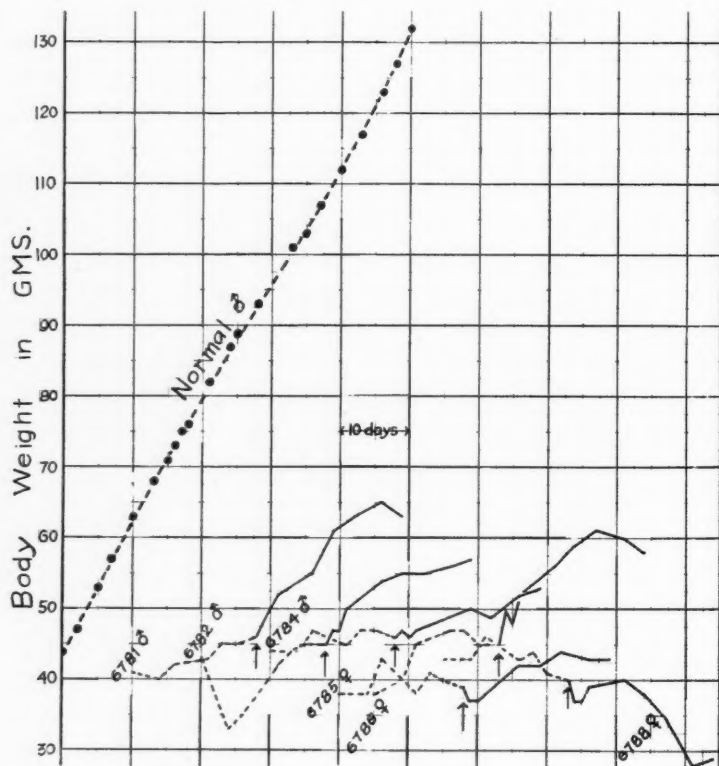


Chart III. Curves showing the retarded growth of young albino rats fed upon a synthetic diet containing 6 per cent of the irradiated wheat embryos as the only source of Vitamin B. At the point marked by the arrow (↑) a Vitamin B-deficient diet was changed to the above diet.

The broken line is a curve of normal growth of male rats fed on a synthetic diet containing 1 per cent of non-irradiated wheat embryos.

diated seedlings gradually stopped growing and soon died.

In order to determine the extent of the Vitamin B destruction we next carried out a similar experiment with a diet containing 6 per cent of the irradiated wheat embryos with the second irradiated lot. These results are given in Chart III.

As may be seen from the growth curves, the growth-promoting Vitamin B was mark-

(On account of limited amounts of irradiated wheat embryos available the experiment lasted for a relatively short period.)

The present study was extended with the third lot of irradiated and non-irradiated wheat embryos. After 10 days of the Vitamin B-deficient feeding, the young rats were given a ration containing 3 per cent of the irradiated wheat embryos and the feeding was continued for two weeks, after which

the rats were transferred to a ration containing 1 per cent of non-irradiated wheat embryos. These results are shown in Chart IV. They indicate that the effect of the growth-promoting Vitamin B in wheat em-

were irradiated two hours without filter the growth of the primary roots was reduced to about 18 per cent of the controls. (Primary roots at 48 hours after the time of irradiation were from 10 to 15 mm. in



Figure 1. Showing 13-day-old irradiated and non-irradiated wheat plants. The young plants from the control seedlings (*A*) show the leaves extended some distance beyond the sheath. The plants from germinated seedlings after receiving 60,000 roentgens (*B*) developed to the stage where the first leaf extended about 12 mm. beyond the sheath, but those from the dry seeds, after receiving 120,000 roentgens (*C*), developed to the stage where the first leaf extended about 2 mm. beyond the sheath or not at all.

bryos is decreased very markedly by heavy doses of x-rays.

In the following experiment we determined the effect of reduced amounts of x-rays upon the growth-promoting Vitamin B. Thus the wet germinated wheat seeds were irradiated under the following conditions: 200 K.V., 30 ma., 0.9 mm. copper filter, 43 cm. distance, and 5 minutes' exposure. Under these conditions the seedlings received a total of about 300 roentgens. The growth of the primary roots in 48 hours in the moist chamber was reduced to about 72 per cent of the controls; on the other hand, when the wet germinated seeds

length, while the control roots grew from 70 to 80 millimeters.)

The embryos were dissected from the irradiated seedlings and dehydrated as before. A feeding experiment was made with a synthetic diet containing 1 per cent of the irradiated wheat embryos and it was found that the growth of young rats was about half of the normal rate during the experimental period of 30 days.

It may be of interest to mention that in the course of the investigation we dehydrated normal and irradiated wheat cotyledons in a vacuum desiccator containing $\text{CaCl}_2\text{-NaOH}$ and found that the normal

non-irradiated cotyledons gave dark brown coloration, while those heavily irradiated gave a straw yellow color in the dried product. This chemical change may be due in

seeds is much more sensitive to x-rays in the wet physiologically active state than in the dry dormant state. It was found that in the wet condition this vitamin was almost

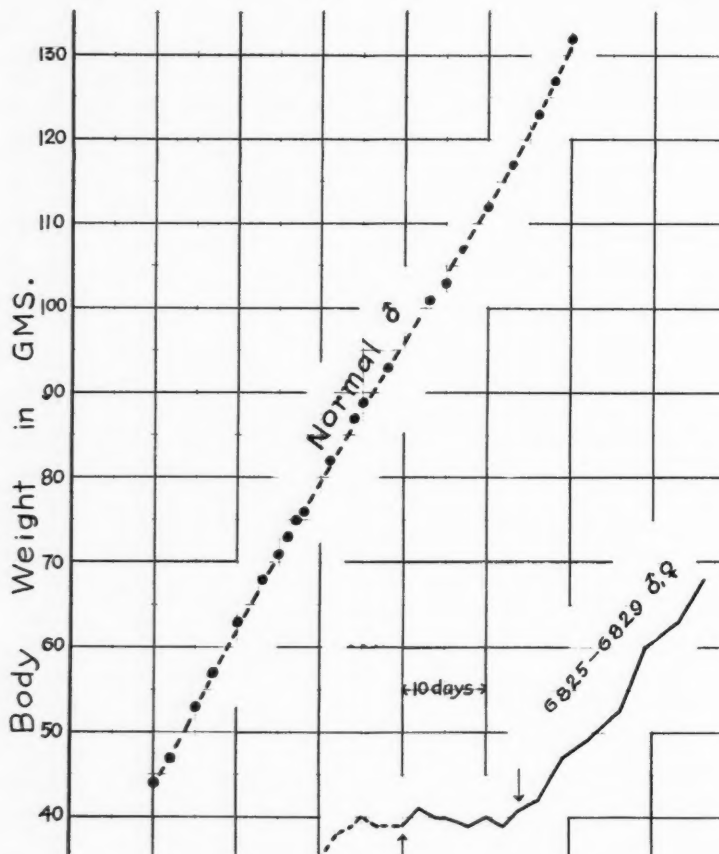


Chart IV. The continuous line indicates the average growth curve of five rats fed on a synthetic diet containing irradiated or non-irradiated wheat embryos. At the point marked by the arrow (\uparrow) a Vitamin B-deficient diet was changed to a ration containing 3 per cent of the irradiated wheat embryos and at the point marked by the arrow (\downarrow) this ration was changed to a ration containing 1 per cent of the non-irradiated wheat embryos. Note the marked increase in growth when given non-irradiated wheat embryos.

The broken line indicates the average growth curve of rats fed on a synthetic diet containing 1 per cent of non-irradiated wheat embryos.

part to an oxidation of organic matters of the cotyledons.

Discussion.—In comparing the results obtained from experiments with dry and wet germinated wheat seeds it will be noted that the growth-promoting Vitamin B in wheat

completely destroyed by heavy doses of x-rays, while in the dry condition, still larger doses caused less destruction.

The water content of the 24-hour germinated wheat seeds was found to be as follows: Whole germinated seeds, 46 per

cent; embryos, 86 per cent. The water content of the dry wheat seeds was 9.3 per cent.

In order to see if there is any relationship between the Vitamin B content of wheat

a total of about 120,000 roentgens. Then the control and irradiated seedlings were planted in soil in flower pots (12 seeds in each pot) and allowed to grow in a well

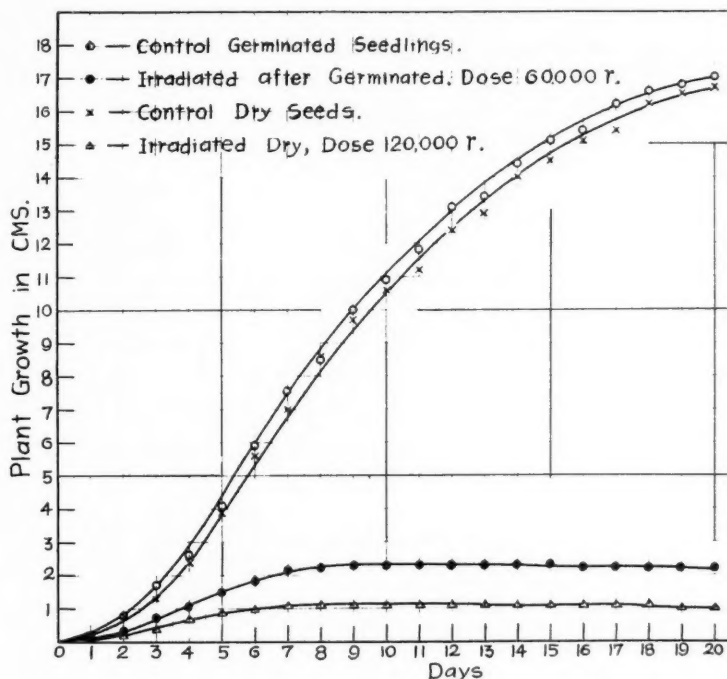


Chart V. Curves showing the growth of the plants of irradiated dry and wet germinated wheat seeds and controls.

seed and the plant growth we carried out several plant growth experiments in March and April, 1932, using wheat seeds, "Kota" variety, 1931 crop.² The doses of x-rays used here were similar to those of the earlier experiments (1930). The germinated seedlings were prepared as before and were irradiated under the following conditions: 200 K.V., 30 ma., no filter, 36 cm. distance and 2 hours' exposure. Under these conditions the seedlings received a total of about 60,000 roentgens. At the same time the dry seeds were irradiated 4 hours, receiving

ventilated and lighted room, the temperature of which was maintained at about 25° C. The irradiated dry wheat seeds as well as the controls were immersed in distilled water immediately after the irradiation for 3 hours at 25° C. and then allowed to germinate 24 hours in moist chambers at about 25° C. before they were planted in soil. The results obtained from this experiment are shown in Chart V. Each point represents the average measurement of 35 or 36 plants.

It is evident that the growth of irradiated dry and wet germinated wheat seeds was markedly reduced. It will be noted also that the irradiated seeds showed a reduction of growth approximately proportional

²The author wishes to express his thanks to Dr. G. Failla, Dr. P. S. Henshaw, and Mrs. Edith H. Quimby for their co-operation and helpful suggestions during the course of the present study.

to the dose, the irradiated dry seeds with 120,000 roentgens growing to about one-half the height of the seeds irradiated after germination with 60,000 roentgens (Chart V and Fig. 1). The development of the plants in each pot is fairly uniform.

12 mm., while each lateral root measured about 9 millimeters. In both irradiated groups, each seed had one primary root and two lateral roots. In the group irradiated after germination (dose 60,000 roentgens) the primary root measured about 6 mm.,

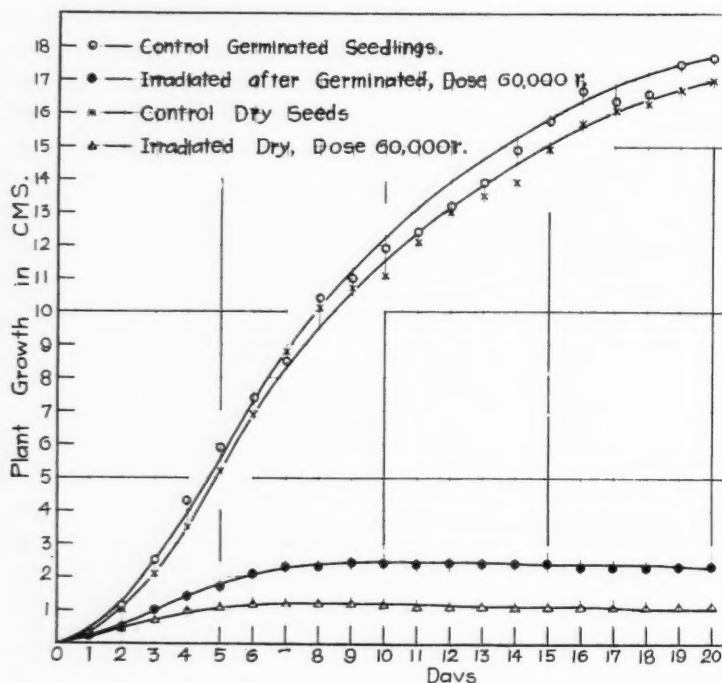


Chart VI. Curves showing the growth of the plants of irradiated dry and wet germinated wheat seeds and controls.

We repeated these experiments with another batch of irradiated wheat seeds prepared under physical conditions similar to those of the preceding experiment, and found that the absolute growth of the plants from the irradiated dry and wet germinated seeds was practically the same as that of the preceding experiment.

On the fifteenth day the plants from the control and the irradiated wheat seeds were removed from the soil and examined. In the control group, each seed had one primary root and from four to six lateral roots. The primary root measured about

while each lateral root measured about 2 millimeters. In the group irradiated dry (dose 120,000 roentgens) the primary root measured about 2 mm., while each lateral root measured 1 millimeter. This experiment was repeated and it was found that in the control group the primary root measured about 50 mm., and each lateral root measured about 28 mm., while in the irradiated group the absolute growth of the roots was practically the same as that of the preceding experiment.

In order to secure further information concerning the radiosensitivity of the dry

and wet seeds, we made the following experiment: The germinated seedlings were prepared as before and were irradiated, together with the dry seeds, under the following conditions: 200 K.V., 30 ma., no filter, 36 cm. distance, and 2 hours' exposure. Under these conditions the wheat seeds received a total of about 60,000 roentgens. Then the control and irradiated seedlings were planted in soil. The irradiated dry seeds and the control seeds were soaked in distilled water for three hours and then allowed to germinate 24 hours in moist chambers at about 25° C. before they were planted in soil. The results obtained from this experiment are shown in Chart VI. Each point represents the average measurement of 36 plants.

It will be seen that the daily growth of plants from the irradiated dry seeds was definitely below that of the irradiated germinated seedlings during the experimental period of 20 days, the former being about half the length of the latter. In other words, the dry and germinated wheat seeds are affected to a different degree by the same dose of x-rays. We repeated this experiment and found that the absolute growth of the plants from the irradiated dry and germinated seeds was practically the same as that of the preceding experiment.

These results show that the effect on the irradiated dry seeds is essentially the same whether a dose of 60,000 roentgens or 120,000 roentgens is used. Evidently, the doses used in these experiments are of greater intensity than is necessary to show the maximum growth changes observed. The relative sensitivity of the dry and wet seeds insofar as growth is concerned, cannot be determined from these experiments. It is the general opinion, however, that the living substances in the wet physiologically active state are more sensitive to the destructive action of physical agents than those in the dry, dormant state.

The foregoing experiments show that the growth of the plants from the irradiated dry wheat seeds was about half as much as from the irradiated wet germinated wheat seedlings in both experiments. On the other hand, the Vitamin B content after irradiation appears to have been considerably different—much greater in the case of the irradiated dry seeds than in the case of the irradiated wet germinated seedlings. It seems, therefore, quite probable that the growth-promoting Vitamin B is not necessary for the nutrition of the plant. However, if plant growth is dependent upon the *presence* of the Vitamin B, such substance is still available in the irradiated germinated seeds since the destruction of the vitamin was not complete.

SUMMARY

1. The growth-promoting Vitamin B in dry wheat seeds was partially inactivated by heavy doses of unfiltered x-rays (120,000 roentgens). On the other hand, this important food accessory substance in wheat embryos was almost completely destroyed when wet germinated wheat seedlings were irradiated with one-half of the dose given to the dry seeds.

2. Our experiments show that the wheat embryos contain abundant quantities of growth-promoting Vitamin B, but that the destruction of the major part of it does not prevent the growth of the seedling.

3. The wheat seeds in the dry, dormant state are more sensitive to x-rays than those in the wet physiologically active state as regards the growth of the plants after irradiation when heavy doses of x-rays are used—over 60,000 roentgens. It is known, however, that this relation is reversed when small doses of x-rays are used.

The author wishes to acknowledge his indebtedness to Mr. Ware Cattell, for his suggestion of the problem, for supplying

materials for the investigation, and for his co-operation in the first part of the study.

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DECHOLIN-SODIUM IN CHOLECYSTOGRAPHY

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From the Gastro-intestinal Clinic and Roentgen Department, Beth Israel Hospital

IN a previous communication (1) the authors have shown that, with the aid of decholin-sodium, a satisfactory gall-bladder shadow may be obtained within three hours after the intravenous administration, or five hours after the oral administration of tetraiodophenolphthalein. Decholin-sodium can also be used safely according to the technic described in order to enlarge the gall-bladder shadow produced by tetraiodophenolphthalein. In the absence of serious liver pathology, failure to demonstrate increase in size of the gall-bladder outline within 45 minutes after administration of decholin-sodium is evidence that the gall bladder has lost its normal capacity to enlarge with the ingress of bile.

The present communication is an analysis of 98 consecutive cases of cholecystography with the aid of decholin-sodium. The technic used is as follows: The evening preceding the roentgen examination, the patient is given a light meal and two hours later the dye (tetraiodophenolphthalein) is given by mouth. If the patient is particularly distressed, sodium bicarbonate may be taken. Ordinarily neither food nor liquids are given to the patient for the next 14 hours, until the roentgen plates are taken. Ten c.c. of 20 per cent decholin-sodium is administered intravenously whether or not the films taken 14 hours after the oral administration of the dye reveal the gall-bladder shadow. Further films are taken 45 minutes later. If the gall-bladder shadow is demonstrated on the films after the intravenous in-

jection of decholin-sodium, the patient is given a fat-protein meal and other films are taken two hours later.

The radiographic technic used was worked out painstakingly so that all films in the individual case were taken with the same kilovolts peak, the same plate-target distance, and the same length of exposure. Films were taken both in inspiration and expiration, the patient remaining in the same position on the table.

The patients studied included those available in a general hospital and out-patient department. In this group were patients with normal gall bladders, patients with definite gall-bladder pathology, and a large group with indefinite digestive symptoms, in whom gall-bladder pathology had to be considered. Patients with peptic ulcer, pyloric obstruction, or marked hyperacidity due to any cause were not included in this study, as these conditions frequently interfere with the normal filling of the gall bladder when the dye is administered orally. A few patients vomited either soon or several hours after the administration of the tetraiodophenolphthalein and in these the tests were repeated or discarded for the purpose of this communication. A small number in whom the examination was incomplete or unsatisfactory had to be excluded from this study for technical reasons.

We have encountered practically no untoward effects from the intravenous injection of decholin-sodium. All the patients experience a bitter taste during or very soon

after the injection, especially when the decholin-sodium is given rapidly. There is little or no complaint if the patient is forewarned. If the decholin-sodium is introduced extraneous to the vein, there may be a local reaction, characterized by pain, redness, and swelling. A few of the patients have pain (never severe, and lasting only a few minutes) in the right upper quadrant soon after the intravenous injection. This reaction is encountered especially in those with gall-bladder pathology. If the decholin-sodium is injected too rapidly, nausea and vomiting of bile may ensue. At present we know of no contra-indications to the injection of decholin-sodium except obstructive jaundice from any cause.

The effect of decholin-sodium upon the normal gall bladder visualized to the roentgen rays by tetraiodophenolphthalein is as follows: The size of the gall bladder increases to a variable extent, the density of the shadow usually becomes less, and its shape and position may be changed. The size of the gall bladder increases both in width and length. Since the degree of distention shows a general tendency to depend upon the location of the gall bladder and varies with the individual, we have divided for the purpose of this study the situation and shape of the gall bladder into several groups. Group I consists of those in which the gall bladder lies parallel to the edge of the liver, partly embedded within it. Such a gall bladder appears on the roentgen film as an oval organ with a tapering fundus, the body being the widest part of the gall bladder. Group II consists of gall bladders placed alongside the vertebral column, the neck only being embedded within the liver. These gall bladders appear pear-shaped, the widest portion being the dependent fundus. Group III represents admixtures of both shapes and positions. The distensibility of the gall bladder is greatest in the pear-shaped organ, the enlargement appearing at the fundus. At the same time, the gall blad-

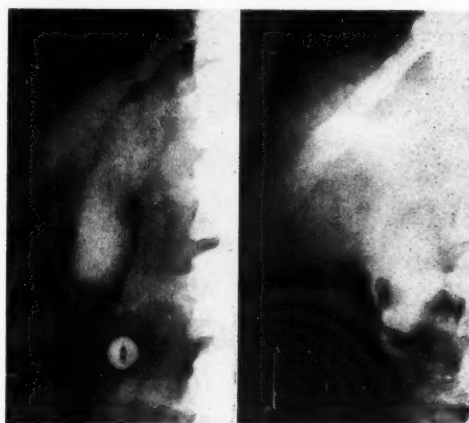


Fig. 1. Gall-bladder shadow before and after decholin-sodium administration. Note the marked dilatation (xxx) of the gall bladder.

der becomes elongated, the neck region being frequently outlined. The oval gall bladder shows less distensibility. With these, however, the body shows the greatest degree of dilatation, the neck rarely being outlined. The third group, intermediate in location, shows the least amount of distensibility and elongation. There is another small group which has been observed in which the dye-filled gall bladder is oval in shape and lies with its long axis horizontal, apparently embedded in the liver. After the administration of decholin-sodium it becomes pear-shaped and changes its position so that the long axis is vertical. In this group the gall bladders show marked dilatation and elongation. Chart I presents the degree of dilatation of the normal bladders on a scale of one to four crosses. Figure 1 demonstrates the dilatation of a gall bladder, vertical in position, 45 minutes after decholin-sodium. Figure 2 demonstrates the change in position of a gall bladder after decholin-sodium, and also a definite diverticulum of the gall bladder. Figure 3 demonstrates a marked degree of dilatation of the gall bladder 45 minutes after the administration of decholin-sodium. Each figure is marked with corre-



Fig. 2. Gall-bladder shadow before and after decholin-sodium administration. Note the change of position of the gall bladder and the diverticulum after decholin-sodium. Dilatation of the gall bladder slight (x).

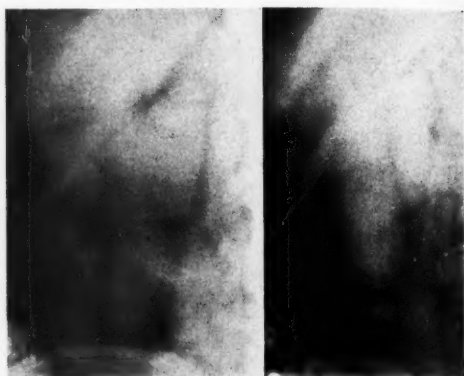


Fig. 3. Gall-bladder shadow before and after decholin-sodium. Dilatation marked (xxxx).

sponding crosses to denote the scale of distensibility.

In a general way we may say that the size of the normal gall bladder varies with its contents much as does the urinary bladder, but, unlike the urinary bladder, the gall bladder has the power of concentration of its contents. It is on this power that we depend to visualize the gall bladder on roentgen plates after tetraiodophenolphthalein. As has been shown by Adlersberg (2), the injection of decholin-sodium causes an increased choleresis, but the liver excretes first the bile salts and water and retains within the body bile pigments and other salts, including tetraiodophenolphthalein, until all excessive bile salts are eliminated from the circulation. This fact explains the diminished density of the gall-bladder shadow following the decholin-sodium, the tetraiodophenolphthalein within the gall bladder being diluted by water and bile salts. In a few cases, however, we have observed an increase in the density of the shadow after decholin-sodium. This phenomenon so far remains unexplained, but we are raising a question as to whether or not it may denote some changes in the excretory function of the liver.

A few cases have been encountered in which the gall bladder did not fill 14 hours after the oral administration of the dye, but filled well 45 minutes after the intravenous injection of decholin-sodium. These cases were classified as normal if the shadow was homogeneous in density, regular in outline, emptying and concentrating well after a fatty meal. None of these cases came to surgery or postmortem examination so that absolute verification was impossible. Two of these cases, however, were re-examined after the intravenous injection of the dye and showed normal filling, dilatation after decholin-sodium, and concentration after a fatty meal, thus confirming our diagnosis. The failure of the gall bladder to fill even after the injection of decholin-sodium does not justify an unqualified diagnosis of pathology within the gall bladder. However, if the same occurs after two or more attempts by the oral route, the diagnosis must be considered very seriously, providing the patient does not vomit the dye and there are no lesions within the gastro-intestinal tract.

In this communication we will not analyze the significance of emptying and concentration of the dye after the fatty meal. Suffice it to say that the significance of this response after a fatty meal is the same in cases in

CHART I

| Transverse | Intermediate | Vertical | Change in Position |
|------------|--------------|----------|--------------------|
| xxx | x | xxxx | xxx |
| x | x | x | xxxx |
| xx | xx | xx | xx |
| xx | x | xxx | |
| xx | x | xxxx | |
| xxx | x— | x | |
| x | x | xxx | |
| x | x | x | |
| xx | xx | xxx | |
| x | x | xx | |
| x | xx | xx | |
| | xxx | xxx | |
| | xx | xx | |
| | xx | xxx | |
| | x | x | |
| | xx | xxx | |
| | | xxx | |
| | | xx | |
| | | xxx | |
| — | — | — | — |
| 11 | 16 | 20 | 3 |

Chart I. Dilatation of the gall-bladder shadow after decholin-sodium. No demonstrable pathology. Note the preponderance of the vertically placed gall bladder. The vertically placed gall bladder is most distensible; the intermediate in location, the least. Dilatability is graded from x to xxxx.

which decholin-sodium was used as in those in which bile salt was not used. We may mention in passing that the mechanism of the dilatation of the gall bladder is entirely different from that of the concentration. Therefore, from the ability of the gall bladder to dilate no conclusions may be drawn as to its capacity to contract after a fatty meal, nor does the gall bladder which does not dilate after decholin-sodium necessarily fail to contract after a fatty meal.

The group of patients studied with decholin-sodium and found to have normal gall bladders consists of 50 cases, many of whom showed no digestive tract diseases. The gall bladder was of Type I, with its long axis horizontal, 11 times; of Type II, with its long axis vertical, 20 times. The intermediate location, Type III, was encountered 16 times. The change of position after decholin-sodium was noted three times. In a general way, the Type I gall bladder was seen more frequently in sthenic, thick-

CHART II

| Transverse | Intermediate | Vertical | Change in Position |
|------------|--------------|----------|--------------------|
| xx | xx | x | |
| xxxx | x— | — | |
| x | — | — | |
| — | xx | | |
| x | x | | |
| — | | | |
| — | | | |
| — | | | |
| — | | | |
| 8 | 5 | 2 | — |

Chart II. Pathologic gall bladders containing stones show no or little dilatability as compared with normal ones. Note one case of excessive dilatability (xxxx). Transversely located gall bladders predominate. Lack of dilatation is marked —; degree of dilatability by x to xxxx.

set, obese persons; the Type II in asthenic, undernourished, ptotic individuals. Type III was encountered with equal frequency in both asthenic and sthenic cases. No conclusions could be drawn about the Type IV gall bladders as only three cases were encountered. Chart I shows graphically the degree of dilatation of the gall bladders after decholin-sodium. The transverse type of gall bladder dilated slightly five times, moderately four times, and greatly two times. The intermediately located gall bladders dilated slightly nine times, moderately six times, greatly once. The vertically located gall bladders dilated slightly four times, moderately five times, greatly nine times, and excessively twice. In the three cases in which a change of position was noted, the dilatation was once moderate, once great, and once excessive.

We had 48 cases in which a diagnosis of pathology in the gall bladder was justified on the evidence obtained by cholecystography with decholin-sodium. The evidence in these cases can be classified under five headings.

1. Failure to fill 14 hours after the oral administration of tetraiodophenolphthalein (16 cases).
2. Failure of the filled gall bladder to

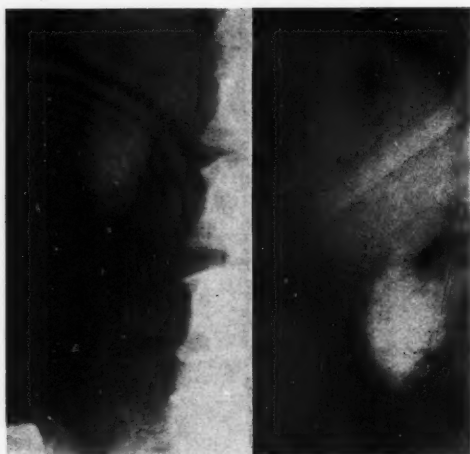


Fig. 4. Gall-bladder shadow before and after decholin-sodium. Dilatation moderate (xx). Note the diverticulum of the gall bladder before and after decholin-sodium.

dilate after the intravenous administration of decholin-sodium (12 cases).

3. Mottled gall-bladder shadow (15 cases).
4. Diverticulum of the gall bladder (3 cases).
5. Pericholecystic adhesions (2 cases).

The cases in which the gall bladder did not fill 14 hours after the oral administration of tetraiodophenolphthalein nor after decholin-sodium and classified as pathologic gall bladders, were carefully re-studied with the intravenous method. Of the 16 cases, five showed definite stones within the gall bladder, two showed no filling after the intravenous injection of the dye, one showed poor filling after the intravenous injection of the dye and no dilatation after decholin-sodium, while one showed some filling in the gall bladder after intravenous injection of the dye, and also a single stone. The other seven cases had two or more routine Graham tests without filling of the gall bladder. Not included in this series are two cases of duodenal ulcer with absence of the gall-bladder shadow after the oral administration of tetraiodophenolphthalein but with



Fig. 5. Gall-bladder shadow before and after decholin-sodium. The fundus of the gall bladder is drawn toward the vertebral column. Dilatation slight (x).

normal filling after the intravenous injection of the dye. We feel certain from the clinical evidence and from the findings after repeated Graham tests that pathology was present in all of these cases.

The failure of the gall-bladder shadow to dilate after decholin-sodium was encountered 12 times. The failure of the gall-bladder shadow to dilate 45 minutes after intravenous administration of decholin-sodium is evidence of changes within the gall-bladder wall, provided there is no marked pathology of the liver. It denotes a thickened, rigid gall-bladder wall, with a fixed capacity for bile, usually met with in chronic cholecystitis with or without stones. It is of interest to note the frequency of the various types of gall bladder in this group. The gall bladder was of Type I, three times; Type II, seven times; Type III, two times. The relative ratio of this type of pathologic finding to the frequency of the types in normal gall bladders is about the same, except that the intermediate type of gall bladder is half as frequent in the pathologic type as in the normal.

The mottled gall-bladder group, cases strongly suggestive of stones or containing definite stones, consists of 15 cases. Figure 2 shows the type of gall bladders and the

presence or absence of dilatation after decholin-sodium. Where dilatation was present, the degree of it is expressed by crosses as in the normal group. Stones may be present within the gall bladder whether the wall is thickened or not. In our experience decholin-sodium is of limited value in demonstrating stones except in those cases in which the gall bladder does not fill 14 hours after the oral administration of tetraiodophenolphthalein, but shows some filling with the dye after decholin-sodium. It is interesting to note the greater frequency of the transverse location of the gall bladder in this group. Six cases showed no dilatation of the gall-bladder shadow after decholin-sodium, five showed only a minimum degree of dilatation, and only one case with a large negative shadow of a single cholesterol stone showed a high degree of dilatation.

A diverticulum of the gall bladder was shown in three cases—Figures 2 and 4 demonstrate two of them. It is of interest to note that, on Figure 2, a diverticulum was demonstrated only after decholin-sodium, while on Figure 4 the diverticulum was shown before decholin-sodium. It seems obvious that some diverticula, perhaps functional in character, are demonstrable only when the walls of the gall bladder are over-distended with the greater ingress of bile, thus demonstrating weaknesses within the walls. From this observation we must conclude that diverticulum of the gall bladder is frequently overlooked in routine gall-bladder examinations. The diagnosis of pericholecystic adhesions on the basis of a

Graham test was made twice. Here the exaggeration of the deformity of the gall-bladder shadow after decholin-sodium is of great value in confirming the diagnosis. In several other cases pericholecystic adhesions were suspected but a definite diagnosis was impossible. We wish to call special attention to Figure 5 and the peculiar position of the gall bladder in this case. At operation, adhesions between the gall bladder, the hepatic flexure, and the duodenum were found.

SUMMARY

The results of observation in 98 consecutive Graham tests with the aid of decholin-sodium are presented. The cases are equally divided into normal and pathologic gall bladders.

Normal gall bladders dilate within 45 minutes after the intravenous administration of decholin-sodium; pathologic gall bladders may or may not dilate. The lack of distensibility of the gall-bladder shadow after decholin-sodium is evidence of changes within the gall-bladder wall and is of diagnostic significance.

Some diverticula and adhesions about the gall bladder are better demonstrated after decholin-sodium.

Decholin-sodium seems to be of very little value in demonstrating stones within the gall bladder.

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AN IMPROVED METHOD OF CHARTING PATIENTS FOR DEEP ROENTGENTHERAPY

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Germantown Hospital, PHILADELPHIA

SINCE the advent of the Pfahler-Kingery saturation method of deep roentgentherapy, many radiologists throughout the country have adopted that technic. Regardless of the technic employed in deep roentgentherapy, it is essential to chart accurately each patient to be treated. One objection that has been raised, however, is the tediousness of charting the patients. To obviate much of the unnecessary expenditure of time and energy, and to make the charts more convenient, and always at hand when treating the patient, we devised the following technic.

An anatomic cross-section chart of the anteroposterior and transverse measurements of the patient, obtained by means of an obstetrical pelvimeter or calipers and reduced to one-half size, is made. The level of the anatomic cross-section is selected to represent the centers of the fields of radiation. The radiologist indicates, from information obtained from the surgeon or from his own knowledge of the case, the general location of the neoplasm, which determines the particular anatomic cross-section level chart to be enlarged. Either the Desjardins or Eyclesmyer anatomic charts are suitable for this procedure.

The cross-section charts are reproduced upon standard lantern slides (4×3.75 in.). These can be purchased or they can be made easily by reprinting a negative lantern slide of one of the cross-section levels, which has previously been photographed, upon another lantern slide. This produces a final positive lantern slide of a reduced photograph of one of the cross-section levels, the result being a transparent slide with the outline imprinted in black. All the desired

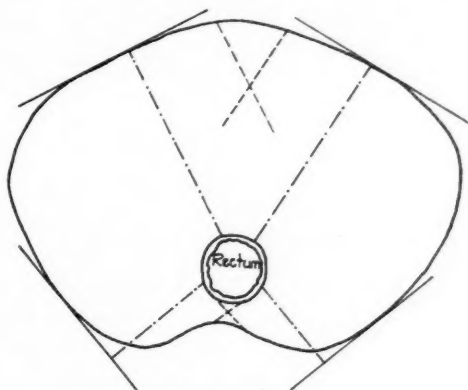
cross-section levels are reproduced upon lantern slides in a similar manner. Depending upon whether the patient is smaller or larger than the average, the anatomic cross-section chart is enlarged or reduced to one-half of the size of the patient to be treated. This can be accomplished by placing the respective cross-section level slide that represents the center of fields of radiation in a Kodak auto-focusing and enlarging device, or in a lantern-slide projector. The one-half size dimensions of the patient having been placed upon the paper, the image is then projected to conform to it. A sketch is made of this cross-section, and the anatomic structures of interest to the radiologist are included. The neoplasm is then located and drawn in by the radiologist.

There is, as a result, a sketch of a plane passing through the tumor area, from which one may determine the size, direction, and number of ports of entry, enabling one to deliver intelligently the desired amount of radiation. To arrange these fields, and to avoid over-irradiation of the uninvolved viscera, tissue, and skin of the patient, we utilize the relative intensity charts. By placing these charts over the anatomic cross-section in various positions, one notes the relative percentage of radiation delivered at different depths beneath the skin. There is the obvious advantage of actually knowing the dose of X-radiation delivered to the neoplasm; in addition, in our opinion, it is not safe to employ a four-field technic, without carefully charting each patient.

The full-size transparent celluloid isodose curves, or relative intensity charts, as they are synonymously termed, are reduced to exactly one-half size by photographing

the original curves upon Eastman process films (5×7 in.), or upon any other film which gives strong contrast. From this film, a positive film is made by contact printing. The final product is a transparent film, with the curves and the data reproduced in black, thus permitting the transmission of light through the film.¹

The half-size tracings were found to be very practical, inasmuch as the schematic representation of the relative skin and depth intensities was of the proper size for reproduction upon standard 8.5×11 in. bond paper. The paper should be sufficiently translucent to allow a re-tracing, by means of transmitted illumination, to be made with ease. On one side of the paper, the conventional "Remarks" are typed, and then mimeographed on as many sheets as are desired (Fig. 1-A). This procedure alone saves much time and energy. On the reverse, the customary tracing of the patient's cross-section level, now half size, is drawn. Then the 5×7 in. film, with the isodose curves imprinted upon it, is placed under the paper, and, by means of strongly transmitted light, the relative intensity curves are traced. This can be accomplished by means of the customary viewing boxes or, more conveniently, with the aid of the device which is illustrated in Figure 2. The degree of overlapping of the protective sheet lead or leaded rubber is also indicated on the cross-section outline at this time, and hatched lines are drawn from these points, which limit the extent of the isodose curves to be drawn. Also, the center of the primary beam is indicated and drawn as it is directed toward the lesion. The distances of these points from the midline, both anteriorly and posteriorly, are measured and doubled, inasmuch as they are now half-size tracings. They are then painted upon the skin of the

REMARKS²

Name—Errickson, Eric
Address—Men's Surgical Ward
Date—March 21, 1932
K.V.P.—200
S.T.D.—50 cm.
Filters—0.5 mm. Cu
 2.0 mm. Al
E.S.D.—800 r = 400 milliamperes-minutes
Skin Intensity—79%
Tumor Intensity—100%
Cross-section—No. 8 Male
Meas.—A.P. 19 cm., Trans. 28 cm.

Fig. 1-A.

patient with mercurochrome.³ The technician may continue the radiation further without the guidance of the radiologist, since he is able, at each séance, to localize accurately the center of the fields of radiation and is informed of the exact overlapping of the protective lead sheeting. This eliminates a considerable amount of the guess-work that is still much too prevalent in deep roentgentherapy.

The remaining data, *viz.*, the relative skin and total tumor intensities, are then computed on the same side of the paper (Fig. 1-B). An additional convenience is the computing of the subtended angles of the central beam of x-radiation, by means of a protractor, which measurements are recorded on the cross-section outline. This facilitates the proper tilting of the therapy tube. It has

¹The different isodose curves for the various kilovoltages, filters, skin-target distances, and diameters of field were compiled by Weatherwax and Robb, of the Radiological Department of the Philadelphia General Hospital.

²In applying this method, it is to be noted that Figure 1-A is a tracing, in part, from Figure 1-B. In reproducing for publication, the former was made on a smaller scale.

³A more permanent stain for marking the skin consists of equal parts of an aqueous solution of gentian violet and 50 per cent silver nitrate.

been our experience, in making these tracings, that the ordinary colored pencils make too thick a line. We have rectified this by using colored Eversharp pencils; more de-

note-book opposite the cross-section paper treatment chart. The chart is always kept in view at each treatment.

There are certain requirements which

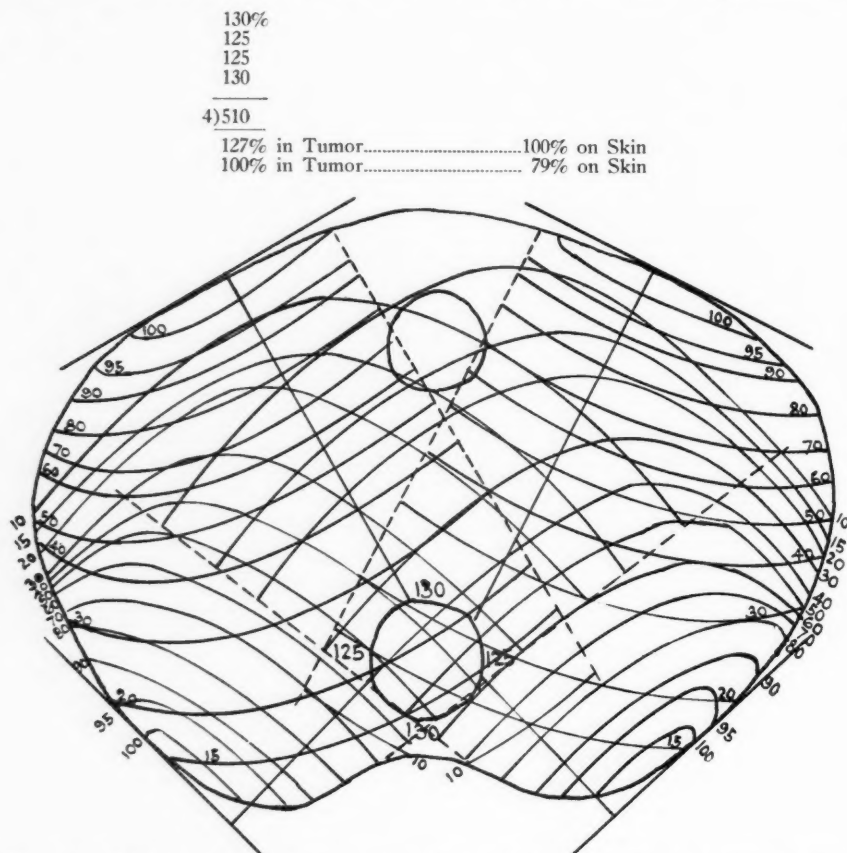


Fig. 1-B. Original tracings of cross-section level with isodose curves and computations.

sirable is the tracing in ink with a fine-pointed fountain pen. Ink has the additional advantage of permanency.

The paper is turned over upon the illuminating device, and the essentials, such as the cross-section outline with region to be irradiated, ports of entry with central beam directed toward the lesion, and the areas of skin to be overlapped by protective lead shielding, are re-traced in ink. The information under "Remarks" is then completed. The paper is then a permanent graphic record to be filed in the loose-leaf

records of dosage technic must fulfill. There must be complete information as to the time-rate of giving radiation, and the system must be so arranged that the radiologist can observe at a glance the progress of treatment. These desiderata are embodied in the graphic method. We have found it advantageous to have the r (roentgens) and days (the ordinate and abscissa, respectively), typed and mimeographed upon the cross-section treatment chart (Fig. 3).

In addition, it has been found desirable to include a brief protocol and progress notes

of each patient (Fig. 5). On the reverse side we occasionally insert an illustration of the area to be treated, imprinted by means of a rubber stamp. We consider this procedure an unnecessary, though useful, re-

one skin area or tumor area, within from three to four weeks. Using the following physical factors: 200 K.V.P., 50 cm. S.T.D., 0.5 mm. Cu plus 2.0 mm. Al as filters, the erythema skin dose has been

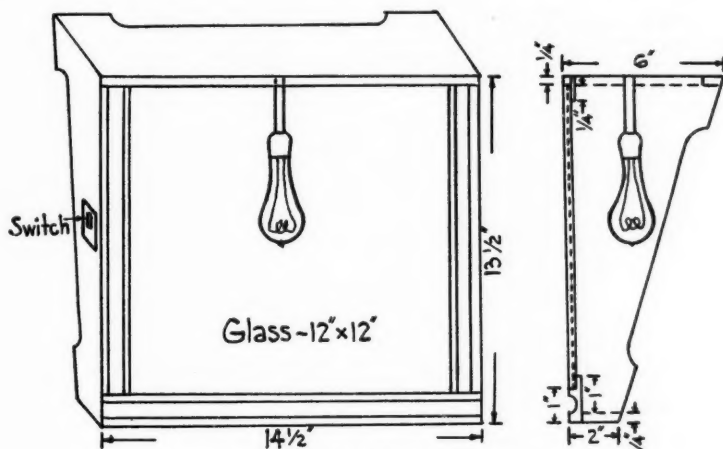


Fig. 2. Sketch of tracing device.

finement. The progress notes are typed and mimeographed.

It is thus seen that three sheets of 8.5×11 in. paper are utilized for a complete and thorough charting of each patient. The chart consists, briefly, of the first sheet which is the protocol and progress notes; the second sheet, a schematic representation of the relative skin and depth intensities upon the anatomic cross-section, and, last, the graphic treatment chart. Upon the latter, we plot the amount of radiation delivered to each skin area—with time, the total amount of radiation delivered to the tumor area—with time, and the rate of saturating each skin area, and we indicate the maximum tumor saturation. The tumor saturation value is based upon skin saturation. The line representing the total amount of radiation delivered to each skin area, with the time, is a useful guide in the determination of the total amount of radiation given. The maximum comprising one series is empirically set at from 2.0 to 2.5 E.S.D. to any

placed at 800 r, exclusive of back-scattering (measured in air). The maximum amount of radiation given with these factors is 1,600 r. However, in using different kilovoltages and varying filters the erythema value changes.

It may not be amiss to state that, if each skin area is treated at each sitting and given identical amounts of radiation, then one curve is representative of the amount of radiation delivered to each of the three or more fields. This is one great advantage in treating all of the fields at one sitting. Furthermore, better results are obtained by treating each port of entry at each sitting. We are then distributing the radiation over four fields, rather than concentrating a large amount over any one area at different sittings, and, clinically, it has been determined that much less skin reaction is thereby obtained.

The skin saturation is stepped up in from 15 to 30 per cent erythema doses (120 to 240 r), applied usually on alternate days.

Then the loss of the residual irradiation effect in the tissue is deducted between treatments, depicted on the graphic record as downward sloping lines. The added quantity of radiation is shown as a vertical line.

Continuing in like manner, we are able to build up to our pre-determined optimum dose or skin saturation. The value of the skin saturation, of course, varies, depending upon the size of the individual, physical factors

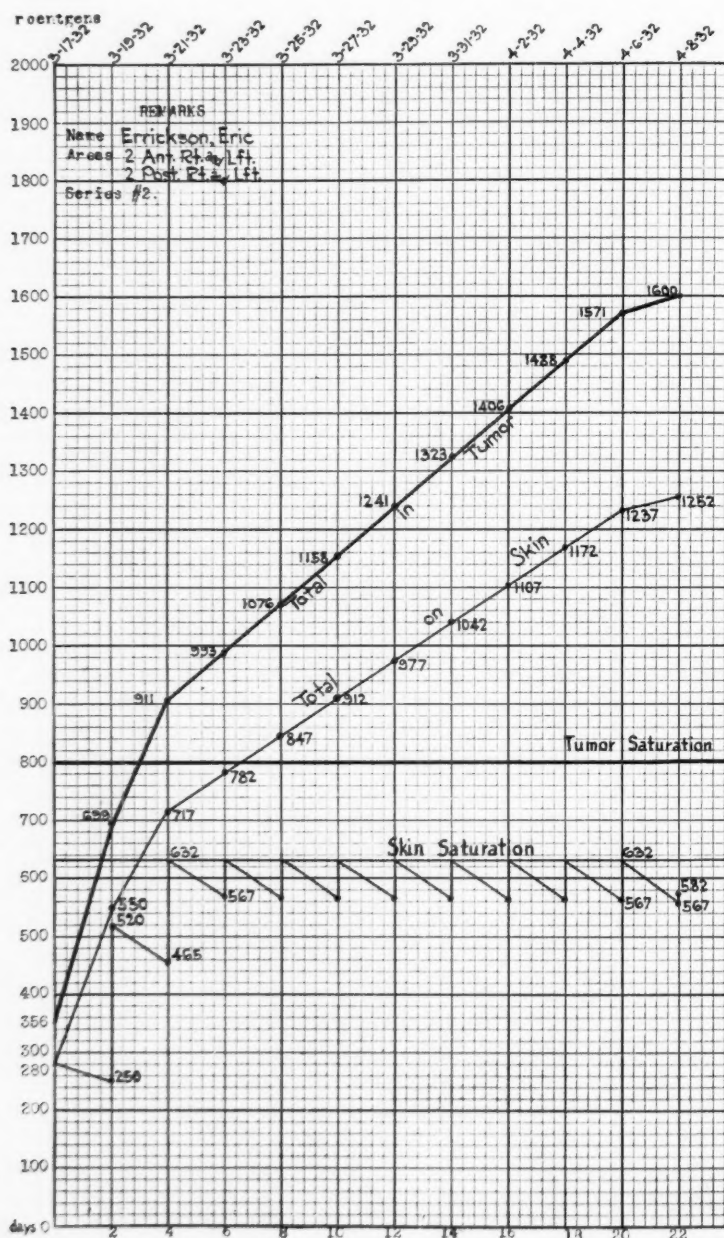
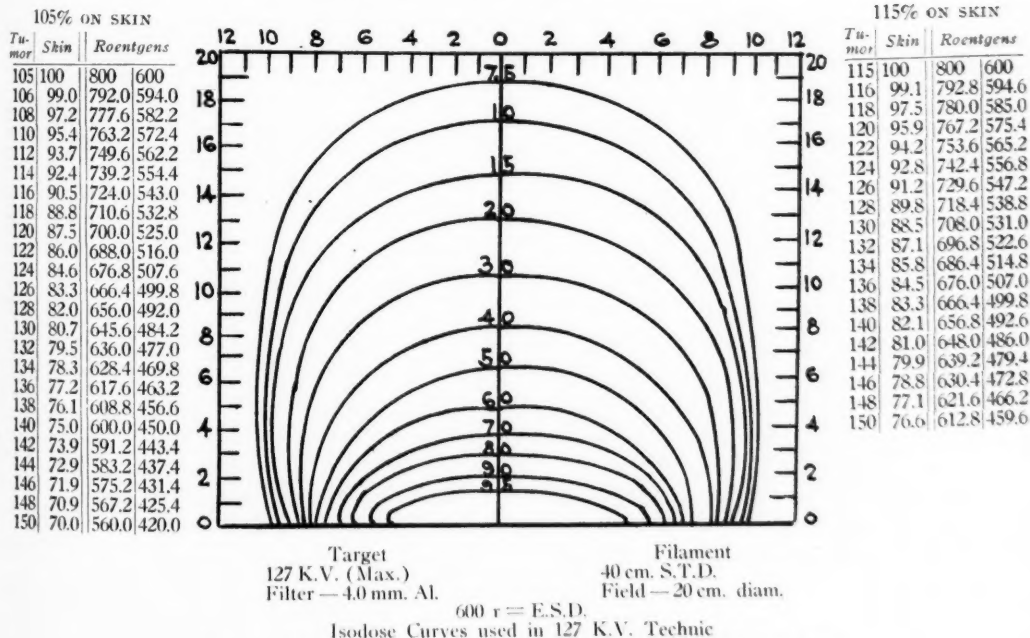


Fig. 3. Treatment chart with mimeographed data; filed opposite finished tracing.



employed, depth of the tumor, and the number of fields utilized; however, the full saturation is commonly between 85 and 100 per cent of an E.S.D. (680 to 800 r), and

is maintained at this level for from ten to twenty-six days. It is readily perceived that it requires from seven to ten days to saturate the skin by delivering about 25 per cent (200

GERMANTOWN HOSPITAL—ROENTGENTHERAPY DEPARTMENT

Name.—Doe, Mrs. J. Address.—2012 W. Main St. Age.—45 Sex.—Female
 Occupation.—Housewife Nationality.—American Weight.—135 lbs.

Family History.—Mother dead—50 years (cancer of cervix). Father dead—60 years (diabetes).

Personal History.—Five children, living and well.

Status Presens.—Chief complaint: Vaginal bleeding and discharge.

One year ago had thin watery discharge which since has become tinged with blood; for last six months there has been irregular bleeding, with occasional clots. Since last month there has been a profuse foul discharge. Slight pain since admission. Has lost 25 pounds in weight during the past year.

Physical Examination.—General appearance cachectic.

Pelvic Exam.: Inspection of cervix reveals a cauliflower-like growth filling the vaginal vault with a friable, bleeding, sloughing mass, surrounded by an indurated ring of cervix. A biopsy was taken. The uterus was slightly movable, showing some invasion of the broad ligaments, bladder, and rectum.

Diagnosis: Clinical.—Cauliflower (squamous-cell) carcinoma of cervix uteri (Class D).

Histo-pathological.—Epidermoid carcinoma of cervix uteri. Mature differentiated spinal cells—Grade 1 (Broders).

Progress Notes:

6/8/32 Vaginal bleeding, with clots and discharge quite marked.

6/10/32 Vaginal bleeding slightly improved.

6/12/32 Almost complete cessation of vaginal bleeding. Slight nausea and vomiting.

6/14/32 No vaginal bleeding. Slight discharge. Patient nauseated. Complains of diarrhea and frequency of urination.

6/16/32 Idem.

6/19/32 No nausea or diarrhea.

6/21/32 No complaints. Patient's general condition markedly improved.

6/23/32 Slight skin irritation anteriorly.

6/25/32 Idem. Patient discharged.

Fig. 5. Reproduction of protocol and progress notes of patient being treated with deep roentgentherapy.

r) of an E.S.D. on alternate days. When this skin saturation is reached, we are able to maintain the level for an interval of approximately two weeks, or until the predetermined 2 E.S.D. tumor dosage has been delivered. The various saturation curves as clinically determined by Kingery and Pfahler have been used as standards by Weatherwax, and he has greatly simplified the curves by plotting curves for various qualities of radiation, giving each its coefficient μ .

From these biologic saturation curves, loss tables have been computed which are a great convenience for routine use. They show the loss in r, percentages, and milli-ampere-minutes.

In contra-distinction to the method of treating each area separately on alternate days, ours patently gives a much more uniform and homogeneous distribution of X-radiation in the tumor and contiguous tissue. It also enables one to deliver a greater total tumor dosage and to maintain this saturation for a short period, during the brief in-

terval of sensitivity of the malignant cells while they are in a state of mitosis. Maintenance of saturation in the tumor is in direct accord with Regaud's recent theories in the radiotherapy of malignancies.

In our experience patients find it more comfortable and less tiresome to change their positions in the irradiation of four fields, during one séance, rather than to remain lying in one position throughout the entire treatment. This is especially noticeable if one uses an air-cooled therapy tube, which requires a greater length of time for the output of the radiation.

It is surprising how rapidly the entire procedure of charting and graphing the patient can be accomplished, with a little practice. The entire technic can be performed much more rapidly than it can be described.

As it is much more convenient to have the celluloid isodose curves remain stationary while one is tracing them upon the paper, we devised the scheme of printing two different isodose curves upon a 14 × 17 film, and cutting the film to fit snugly the tracing

device described. The dimensions of the film will then be 12×12 inches. In addition, along the outer borders of the film, we have four sets of computations printed for the conversion of the relative tumor and skin intensities, and also their equivalents in r. This is accomplished by taking the negatives of the printed percentages and isodose curves and making positives upon the large film. As each area is printed, the other areas of the film are shielded from the light, and, after being developed, the finished product will have the appearance shown in Figure 4. We have found it more convenient to build a larger illuminating device than that described, accommodating a 14×17 film, upon which four isodose curves are printed by the contact method described above. The computations for the conversion of the relative tumor and skin intensities have greatly facilitated the determination of the amount of radiation to be delivered through the skin, inasmuch as the skin of most pa-

tients receives additional transmitted radiation from the opposite side. The total skin intensity is then converted to 100 per cent E.S.D. and the relative tumor intensity is determined at the same time. Or, if one decides to make the tumor saturation equivalent to 100 per cent, then the relative skin intensity is also determined by merely referring to the conversion table.

In small cross-section levels, such as the neck, we have continued to utilize the full-size procedures.

SUMMARY

Our modification, we believe, has the manifold advantages of economy, uniformity, conciseness, celerity, and convenience, all of which are of paramount importance in deep roentgentherapy. It is our conviction that the finished charts are of inestimable value to the radiologist, and indispensable in collecting statistics or evaluating the end-results of his roentgentherapy.

ANGIOPNEUMOGRAPHY

By DR. E. CONTE and DR. A. COSTA, TURIN, ITALY

From the Radiological Institute of the Medical Section of the Hospital Mauriziano Umberto I, Turin, Italy

THE term "angiopneumography" has been proposed by E. Monez and his collaborators to indicate the radiographic image of the pulmonary vessels which is produced by the injection, into the lesser circulation, of a liquid opaque to the roentgen rays.

To obtain such a visualization Werner Forssmann resorted to a procedure which he first tried on himself and then on his patients. This consisted of the introduction of a catheter into an arm vein as far as the right auricle. The opaque liquid was then injected through this catheter. Forssmann injected 20 c.c. of a 40 per cent solution of uroselectan. Since the content of organic iodine in this compound is 51.5 per cent, he

introduced 4.12 grams of metallic iodine. The experiment failed because of defective roentgenographic apparatus.

The above-mentioned Portuguese authors, Monez and his collaborators, were the next to study the problem. They introduced into the human heart by way of the arm veins a specially constructed catheter, and through this injected very rapidly 6 c.c. of a 120 per cent solution of sodium iodide. Since this salt contains about 84 per cent of iodine, the quantity of metallic iodine injected was close to 6.94 grams. In earlier studies these workers had observed that if the opacity of the blood circulating in the lungs was to be appreciably increased, the iodine concentration in the pulmonary cir-

culatation must reach a concentration of about 1.7 grams per cent. If the cardiac output per beat is calculated as 100 c.c., it may be assumed that this concentration was attained with the method used.

ficient quantity of a highly opaque liquid into the pulmonary circulation by way of the heart, and, above all, to make the procedure safe. The opaque liquids generally used for these experiments are various more or

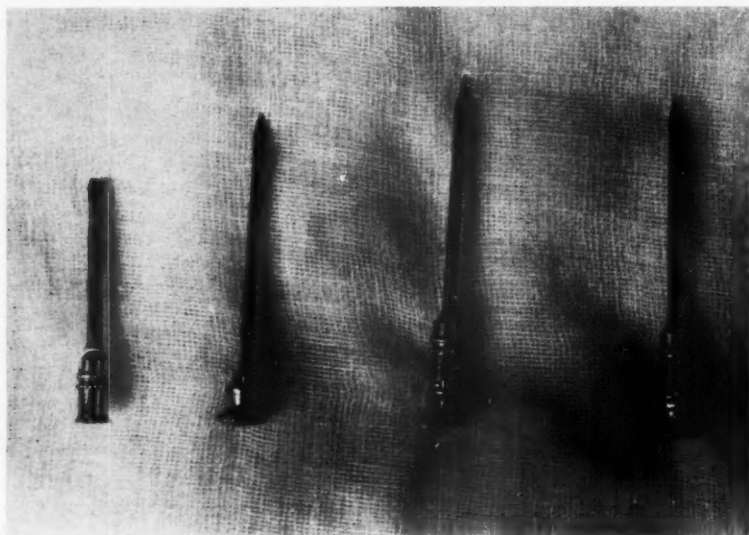


Fig. 1. The needles used for threading the catheter.

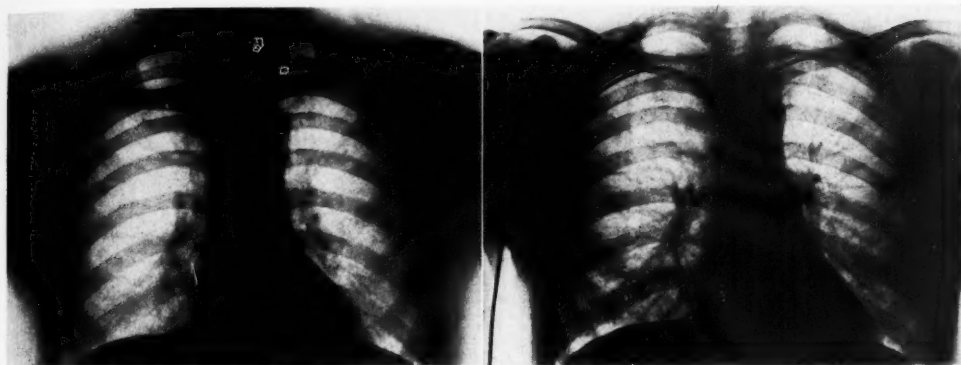
Our studies, which were contemporaneous with those of the Portuguese workers, were carried out first on animals, then on man, and were reported at the Turin Radiological Conference in November, 1931.

Then followed the studies of Ravina and his collaborators, carried out solely on animals and on anatomical preparations. The profuse illustrations accompanying their paper indicated the diagnostic possibilities of angiopneumography. Next to appear were two further papers by the above-mentioned Portuguese authors.

Our own method, which differs materially from that of the Portuguese workers, has been developed over a long period of time and from a variety of experiments. We think that it may now be considered to be applicable in diagnostic practice.

Our purpose has been to introduce a suf-

less concentrated solutions of iodine. The Portuguese workers adopted a concentrated solution of sodium iodide (120 per cent). Formerly we also preferred this solution, because of its great concentration and its high iodine content. In our hands, however, this solution, although prepared exactly as the authors direct, has not continued to satisfy the indispensable requirements for a liquid to be used in research of this kind. In one of the subjects who voluntarily submitted to the experiment, immediately after the intracardiac injection of 6 c.c. of a 120 per cent solution of sodium iodide we observed violent tetany involving the muscles of the extremities and the trunk, and such serious slowing up of respiration and fall of blood pressure as to cause fear for the patient's life. Such incidents, we think, are rare, and are related to the great differences



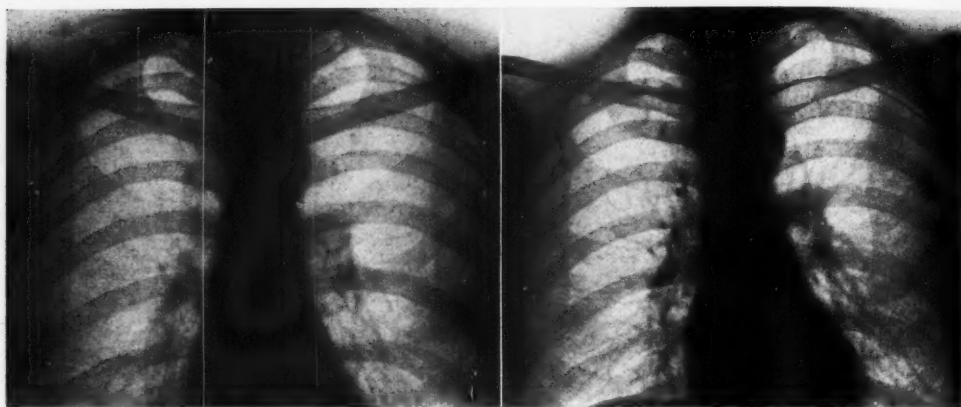
Figs. 2-A and 2-B. Roentgenograms (*A* before, *B* after) made after the injection with two catheters.

in individual sensitivity to the toxic action of the iodine which is set free in the fluids of the body. According to the experiments of Sgalitzer, Boehm, and Henri Yean, this same toxic action is the cause of the appearance of pulmonary edema and pleural effusion following the administration of massive doses of sodium iodide. This fact is naturally a contra-indication to the use of the iodide in experiments on subjects with tuberculous lesions, even though healed.

To us it seems preferable to use compounds in which the iodine, although present in a lesser percentage than in the iodide, is fixed in such a manner that it is not set free in the body fluids. This requirement is well met by abrodil (sodium moniodometansulphonate), which contains 52 per cent of metallic iodine. After many trials we have been able to obtain a highly concentrated aqueous solution of this preparation (up to 100 per cent), which we are using at present in phials of 10 cubic centimeters. In order to increase the opacity we add 2 grams of sodium iodide to a phial (certainly an innocuous dose), so that each phial contains a total of 6.88 grams of iodine. This mixed solution has shown itself to be perfectly adapted to our research, and has been well tolerated by every patient.

In order to hasten the arrival of the solution in the heart we have made use of a

procedure which we proposed to facilitate the study of the composition of the blood in the deep vascular regions of the body. This consists of the insertion up to the heart of two catheters, one through a vein in each arm. It should be emphasized that this procedure is in no way a dangerous one. Forssmann, who developed the method, tried it first on himself. The writer has examined at autopsy the endothelium of the vessels penetrated by the catheter and also the endocardium, in the case of a very sick patient in whom the procedure had been utilized in order to administer medication directly in the heart. Ravina and his collaborators have made exact and extensive pathologic studies of animals in which cardiac catheterization has been done, and in which the catheter has been pushed through the left ventricle as far as the pulmonary arteries, and they have never observed lesions of the endothelium. No one has observed any ill effect in patients, excepting, of course, that resulting from the injection of toxic solutions. The only disturbance we have seen has been a temporary phlebitis of the veins of the arm in cases in which the catheterization was particularly long drawn out. This has subsided in a few days with the application of moist compresses. Recently one of us volunteered to have the procedure repeated on himself. He suffered no ill effects. The



Figs. 3-A and 3-B. Roentgenograms (A before, B after) made after the injection with only one catheter.

only effect of the injection which we use has been an insistent metallic taste in the mouth. The resultant phlebitis has been minimal, making all therapeutic procedures unnecessary.

The procedure which we have used is as follows: The patient is examined when supine upon a thoracoscope. A large needle with an obturator of the proper construction (see Fig. 1) is introduced into the cubital vein. This needle is of sufficient caliber to permit the passage of a Charrière No. 8 ureteral catheter (opaque to roentgen rays). After the obturator has been withdrawn the needle is threaded with the catheter, which has previously been sterilized and then lubricated both inside and out with olive oil and provided with a filiform obturator made of brass or non-oxidizing steel. The catheter is pushed slowly through the veins of the arm, the subclavian, the innominate, the superior vena cava, and as far as the right auricle, its progress being followed and controlled fluoroscopically.

The same procedure is followed on the other side.

The catheters usually stick when they reach the level of the clavicle. This is due to the difficulty of making them follow the bend from the subclavian into the innominate and the superior vena cava. A few

words of advice as to how to overcome this obstacle may be of assistance. The catheter should be blunt because a slender, pointed tip bends too easily. It should have an opening in its tip which permits the liquid to be injected to run out easily. Sometimes it helps to rotate the catheter on its axis, to abduct or adduct the arm, to apply pressure in the supraclavicular fossa, or to apply traction to the tissues of the supraclavicular fossa. Another suggestion is to partially withdraw the obturator, but it is necessary to take care in pushing it back into the catheter in order that it may not be obstructed by a blood clot.

When the catheters are in place the patient is placed upon the roentgenographic cassette, the obturators withdrawn, and two syringes each containing 5 c.c. of the opaque liquid are attached to the respective catheters. The injection is made as rapidly as possible (2-3 seconds), and when all the liquid has been introduced the roentgenographic apparatus is released (Fig. 2).

It is not always possible to get both catheters past the obstacle at the level of the clavicle. This is particularly the case on the right side where the arc to be traversed is more acute because of the anatomical disposition of the venous trunks. The procedure may, however, be carried through

with only one catheter in place, the result being nevertheless quite good (Fig. 3). In this case the flow of the opaque liquid is naturally a little slower, being impelled by only one syringe.

With our technic seven times as much iodine can be introduced into the pulmonary circulation as by the primitive method suggested by Forssmann, in the same amount of time, while the liquid remains equally innocuous.

As regards results, we must remind the reader that the method is still in the evolutionary stage. Up to now we have been concerned with the details of technic, and have, therefore, almost always worked with healthy individuals. We are only now entering the field of pathology.

Having carried out the procedure on one case of mitral insufficiency with pulmonary stasis, we are able to state that the congestion of the vessels makes the image obtained by angiopneumography confused and unusable.

We believe also that the injection of opaque liquid does not succeed in increasing the opacity of the right heart to any appreciable extent in man. This is contrary to what has been observed in smaller animals (rabbits and dogs).

Angiopneumography proves that the hilar shadow and the so-called parahilar striae are,

for the most part, the shadows of vessels. The same holds true for the striae which are often seen running toward the apices. These latter vary greatly in size and direction in different subjects, and are, therefore, particularly difficult to interpret in ordinary roentgenograms, particularly in the presence of the apical lesions of tuberculosis which are a common pulmonary finding. Without doubt angiopneumography resolves these doubts.

The comparison of roentgenograms taken before the introduction of the opaque liquid with those made afterwards shows that the image of the network of narrow criss-cross striae which is interpreted, particularly in the subclavicular region, as being the result of tuberculosis, is merely the projection of the network of vessels, and that the small groups of nodules are only the points of bifurcation of small vessels.

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ACNE VULGARIS FROM THE RADIOLOGIC STANDPOINT¹

By BENJAMIN H. SHERMAN, M.D., HOLLYWOOD, CALIFORNIA

ETIOLOGICALLY considered, the discovery of the *Bacillus acne*, the organism of acne vulgaris, by Gilchrist, in 1902, made it seem logical that to prepare a vaccine which would completely resolve the treatment into a matter of routine would be a comparatively easy matter.

¹Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30-Dec. 4, 1931.

Since that time all kinds of mixtures have been tried with but mediocre success. We have been taught that acne is caused by impurities in the blood, foci of infection, sexual irregularities, diet, menstrual disorders, thyroid disturbances, constipation, chlorosis, digestive disturbances, etc., all of which are well known alibies or, to say the least, doubtful contributors. There is some rea-



Fig. 1-A. Unretouched picture of a case of mixed acne of six years' duration.

son, to believe that many of the above conditions have their influence on the disease, but as to the exact etiology no one seems to be able definitely to isolate the specific factor. It is our opinion that acne vulgaris is purely a localized disorder and probably can be explained on the basis of inability of the pores to throw out an unwelcome invader.

Cunningham and Lunsford (1) have made a comprehensive study on the etiology of acne, using some six thousand students of the University of California as subjects. Their conclusions are:

1. Acne lesions are found more frequently on the backs of young women than on their chests and more frequently on their chests than on their faces.

2. More young women in the 15-to-24 age-group have acne than in the 25-to-34 age-group.

3. Nutrition, as expressed in weight deviation from a selected standard, is not a determining factor in acne incidence.

4. Complexion is without significance when the amount of acne present is considered.

5. There is no relation between the presence or absence of acne in the 15-to-

24 age-group and such menstrual characteristics as age of beginning, duration, irregularity of interval, amount of pain, or amount of flow.

6. A history of boils, constipation, appendicitis, and tonsillitis has no appreciable bearing on the incidence of acne.

7. Foci of infection in the nose and throat may favor the development of acne.

8. Thyroid enlargements are associated with a slight increase in acne incidence.

Thus it seems that many of our preconceived ideas about the etiology of acne are not founded upon facts or clinical observations.

Clinically, acne vulgaris may be divided into four groups:

The *comedo type* is characterized by blackheads, a very oily skin, and a few papules and pustules. This type is markedly amenable to treatment with the x-ray.

In *acne erythematosus*, the redness of which is quite diffused over the face, back, or chest, or on all three, there usually are some papules and pustules and the erythema may be confined to an areola around the pustules. This type is not so amenable to irradiation, and great caution should be ex-

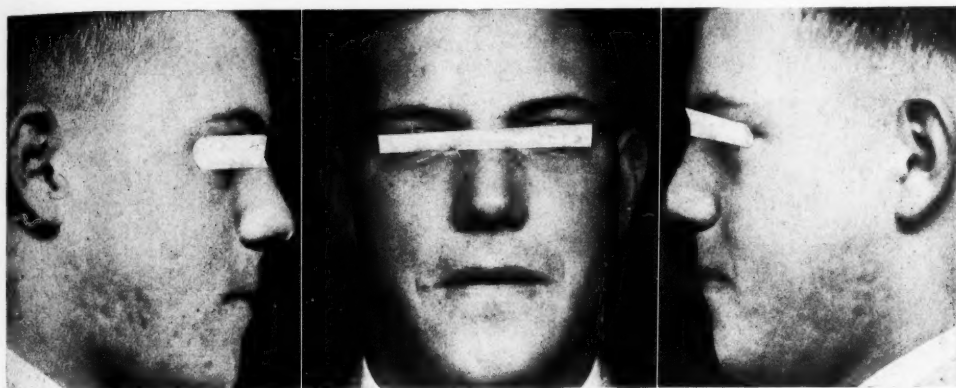


Fig. 1-B. Unretouched picture of same case three months later. Treatment limited to the x-ray.

exercised in treating patients. Attention should be given also to the usually attending systemic conditions.

The *papular type* consists of lesions, comedones, and papules, especially about hair follicles, which are quite amenable to the x-ray.

Lastly, we have *acne indurata*, which, as its name implies, is identified by indurated masses containing pus or cystic material in the subcutaneous tissues. It is chronic and persistent and disfiguring scars remain after evacuation of the masses. These deep-seated pustules are many times dormant and may degenerate into cystic formations which remain over a long period of time. It is in this type that the x-ray is most efficacious, especially in eradication of the disease. Here, too, we have the most scarring, for, because of the many times pus has been evacuated, we see pox marks which cannot be effaced. It is well to apprise the patient of the fact that, although the x-ray may check the infection, only time can diminish the size of the scars.

Of all the pyogenic diseases we are called upon to treat, acne vulgaris is one of the most important, due to its destruction of the skin's surface. Inasmuch as the face is a frequent site and that every day the disease is active destruction is greater, it behooves

us to stop its action at the earliest possible time.

This paper is based upon the results obtained over a period of 27 years in treating acne in its various forms with the x-ray.

Before beginning treatment, there are a few simple rules to be followed if one would avoid trouble. First, a photograph which will accurately register the condition should be taken—both frontal and lateral views. Should the chest or back be involved, photographs of them will also be necessary. The office of these photographs is not only to have a check on the progress of treatment, but also to have some check on the condition previous to treatment in view of the fact that, as the pustules and indurations are cured, scars become more conspicuous and form the main disfigurement. It is this scarring which has led even physicians, to say nothing of the public, to make statements that the effect of the x-ray is to cause unsightly scarring. Nothing could be farther from the truth. The fact of the matter is that the x-ray, having removed the indurations and pustules, uncovers what the disease has been doing to the skin over a period of months or years preceding the institution of therapy. It is true that there is danger in using the x-ray, and a grave danger if one is to follow some of the advice



Fig. 2-A. Unretouched picture of a case of acne indurata of four years' duration.

given, even in text-books. Over-treatment will replace a simple infection with an acutely scarred skin, and it should be borne in mind that some patients scar more readily than others.

The second rule refers to caution in prognosis. One should be most careful here, for, in a disease so highly amenable to the x-ray as acne indurata, in which we see improvement and cures every day, it is easy to become careless and to assure our patient that the cure will take about two or three weeks and let it go at that, when, as a matter of fact, we know better. We must not lose sight of the fact that mild cases oftentimes are the hardest to improve, and these patients are many times the hardest to control. As a rule, the worse the condition, the quicker one gets tangible results.

Third, we should impress on the patient the fact that there may be acute exacerbations during the course of treatment, and that it takes months to get the relief the x-ray offers. Given a patient of average intelligence, a short explanation of just what you are trying to do, and why, will help you out in many instances. It is well to inform the patient that any carelessness in diet, or other indiscretion, may produce an acute exacerbation which will prolong the treatment weeks, or months, and will increase the scarring and pitting on the face which, of

course, is one of the things we are trying to avoid. The main reason for using this form of treatment is to stop pitting of the skin as soon as possible, for it is now recognized that the x-ray stops acne, especially acne indurata, in from one-fourth to one-third the time the disease could possibly be checked in any other way.

PROGNOSIS AND ADVANTAGE OF X-RAY TREATMENT

It has been conceded that the roentgen ray is the basic factor in the treatment of acne vulgaris, and many cases yield to it alone; but, although this is true, one can easily abuse it. The worst abuse, however, lies in our failure to search out any internal cause. Roentgentherapy is also abused in the administration of excessive doses of x-rays. Following this closely comes "prolonged treatment" which, of course, may hinge on the above, for, if the basic cause of the condition is not found and corrected, we will logically have recurrences.

When a patient is referred for roentgentherapy, it is best to see to it that the medical adviser is kept in close touch with the patient. We should not treat the patient as a case handed to us after the doctor has failed, but, rather, on the basis that the doctor seeks the x-ray as an additional aid in curing the condition.



Fig. 2-B. Unretouched picture of same case four months later. Treatment limited to the x-ray. Note that the pitting persists.

What a patient wants to know is, "Will the x-ray cure my face?" To this, I believe our answer should be given in percentages. MacKee (2) in his series of 244 cases treated with known results, gives the following figures:

| | |
|---|---------|
| Total number of patients treated with the x-ray..... | 244 |
| Number of patients cured within four months | 147—60% |
| Number of patients requiring more than four months..... | 84—35% |
| Total number of patients cured..... | 231—95% |
| Total number of failures..... | 13— 5% |
| Total number of patients who had one recurrence..... | 37—10% |
| Total number of patients who had second recurrence..... | 2—0.8% |

These figures are a little above the average, perhaps, but they should be attainable if one co-operates with the referring physician. We have disregarded in every instance the overworked expression, "in selected cases," and have taken all patients just as they came, regardless of type or intensity of infection, age, sex, or length of duration of the disease. However, we are careful to check the patient as to previous treatment and length of time since previous application of the x-ray.

One must keep in mind that many doctors who own x-ray machines, but have not gone deeply into the subject, who have no idea of what a skin unit is, or possibly no way of judging what the patient is getting, have read that roentgentherapy is good for acne and have acted upon this advice. I have taken occasion to check up on this type of treatment from the dermatologists' standpoint, and I believe I have discovered why many of them are not too optimistic about roentgentherapy. In going over the type of literature they have access to, I find such statements as this: "The exposure [referring to the x-ray] should seldom exceed from five to seven minutes in duration, given every five days" (Hartzell, 3). Stelwagon (4) says: "A soft-to-medium tube should be used. The exposure should be made cautiously, at from ten to fifteen inches' distance and for from three to four minutes' duration, one to three times weekly." Sutton (5) says: "Radiotherapy, properly employed, at present constitutes one of the most valuable remedies we possess in the treatment of this disease. The dose is one-half skin unit, at intervals of from one to four weeks for four doses." Here we see the widest extremes in doses. It is hard to conceive what would happen should we use the method prescribed by Hartzell (3), for

with our technic it would comprise over two skin units every five days.

Nearly every one of these authors states

mention is made of milliamperes, kilovolts, or time, and only one author consulted mentioned distance.

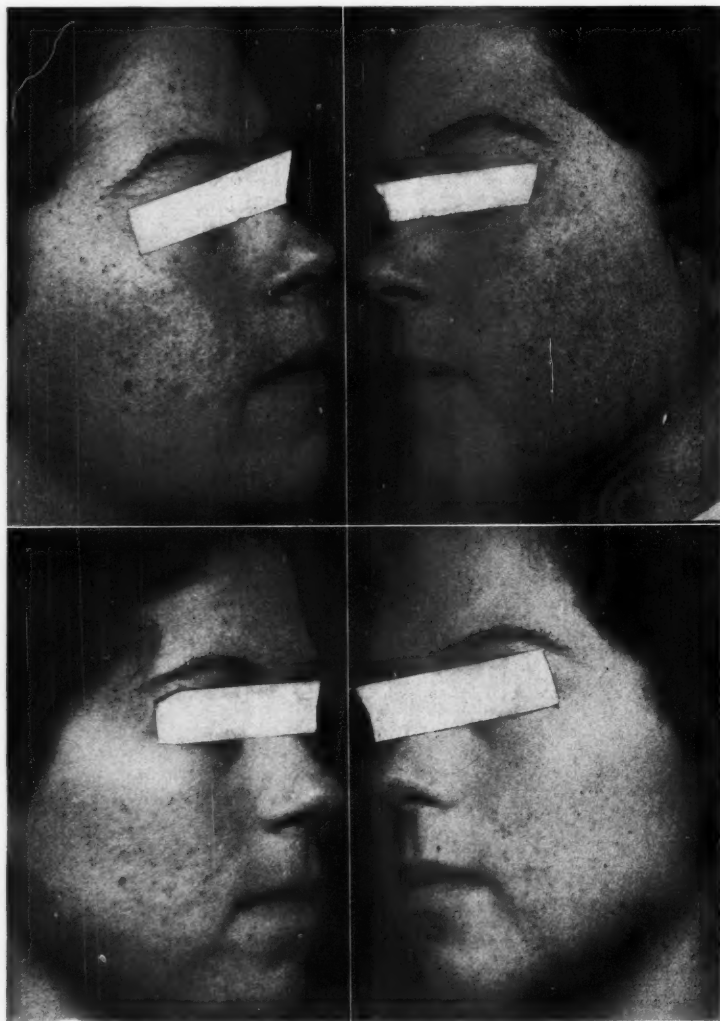


Fig. 3-A (*above*). Unretouched pictures of a case of acne papulosa and pigmentosa of three years' duration.

Fig. 3-B (*below*). Unretouched picture of same case two months later. Treatment limited to the x-ray.

that he reserves the x-ray for "persistent, rebellious cases." With the technic as before given, it is quite reasonable to believe that poor results would be expected. No

Care should be exercised that all pustules and indurations may be drained at the proper time. Many innocent-looking papules will be found to harbor pus. One soon

becomes expert in detecting those which contain pus, even in the deep-seated indurations.

One point that has helped us materially in treatment has been to treat first without filter, giving one-fourth of a skin unit twice a week. This takes care of the small, superficial pustules and papules. The next four or five weeks, follow up with one-third of a skin unit through 2 mm. Al per week. I give this plan for what it is worth; it has proved acceptable in our hands.

Set-up.—It seems wise to have a fixed set-up to be used at all times as far as practicable. This can be worked out as follows: First, have your meters thoroughly checked, using 2 mm., if possible. The standard voltmeter seems to be fairly reliable. This having been done, the use of the old formula, $\frac{\text{Ma.} \times \text{K.V.}^2 \times \text{T}}{\text{D}^2}$, will give a good working basis.

For example, we use 4 ma., 100 K.V., and a standard distance of 12 in., time being the only variable factor except in instances in which filters are used. Taking the factor 960 as the average erythema dose and using our factors just mentioned, we get the following results: $\frac{4 \times 100^2 \times 3.5 \text{ min.}}{12^2}$

$= \frac{140,000}{144}$ or 960. It is easy to figure one-fourth or one-third skin unit, as the case may be. But this or any other method of measuring is subject to great error, and for best results an erythema test given to each patient is the safest. This consumes time, but the roentgenologist will be well repaid in the end.

We have used, also, the direct method of measurement with the iontoquantimeter, but find that for all practical purposes the formula, or erythema, method does very well. Until some instrument is invented that can measure skin tolerance to the x-ray, we will be compelled to adhere to the above rules, being satisfied to keep close watch of our patient and to use our best judgment in

adapting our treatment to that particular skin.

Treatment may be given by the unfiltered method and should be fractional. One or two tubes designated as acne tubes should be used, due to the wide variance in tubes. If a second tube is necessary, it should be matched as nearly as possible to the first one. A. W. Erskine (10) has pointed out the variance in x-ray tubes, saying that there is as much as 40 per cent variance, and one can easily figure how it could cause serious trouble. He recommends using 1 mm. Al as a permanent filter, which will obviate much trouble. Michael (6), Hazen and Eichenlaub (7), Crutchfield (8), MacCarthy and McCafferty (9), and many others use unfiltered radiation with good results.

CONCLUSIONS

1. Basic causes should be sought for and corrected.
2. Systemic treatment should be instituted in all cases that show systemic disturbances, such as menstrual disorders, gastric disturbances, focal infections, glandular dyscrasias, and the like.
3. No one has satisfactorily established the exact etiologic factor.

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PRACTICAL APPLICATION OF CHOLECYSTOGRAPHY¹

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IN the past eight years, visualization of the gall bladder by radiopaque dyes has been used the world over to study the function of the gall bladder and the relation of its function to cholecystic disease. Owing to the prevalence in adults of biliary tract disease, this laboratory test is being employed more extensively each year. Graham and his co-workers (1) state that various studies indicate that from 20 to 25 per cent of all adults have gallstones and that probably an equal number have cholecystitis without stones. Thus, about 40 per cent of our adult population have disorders of the biliary system which, in probably the majority of instances, are at times associated with more or less severe symptoms. Too much work cannot be done to enhance our methods of diagnosis. With this view in mind, a careful search into the work done on cholecystography at the Cleveland City Hospital has been carried out to determine the value of this procedure.

A few months following the publication of the preliminary report on cholecystography, in 1924, by Graham, Cole, and Copher (2), by the intravenous injection of tetrabromphenolphthalein, the Hospital adopted the procedure rather cautiously. Later, enthusiasm waned as unpleasant reactions were encountered and reported in the literature, but as time went on, intravenous cholecystography became a routine procedure on hospital patients presenting symptoms of gall-bladder disease. At first, owing to the occasional severe reactions which took place, not all patients with symptoms of cholecystic disease were subjected to the test. Extreme caution was exercised in handling these patients, and even though no deaths occurred, the method was abandoned

completely at one time. When Menees and Robinson (3), in 1925, advocated the new method of oral administration of the dye with less possibility of disturbing reactions, a renewed effort was made to carry on the work. With the exception of two cases in 1925, the oral method was used exclusively during that year, 1926, and the first six months of 1927. The bromine compound was used before 1927 for the intravenous administration, but after the resumption of the intravenous method in 1927, the iodine compound in the form of sodium tetraiodophenolphthalein was employed. Whitaker and Milliken (4) showed, in 1925, that the iodine compound cast a more intense shadow with less dosage and less toxic effects than the bromine compound. Both the oral and intravenous methods have been followed since that time to the present. Various types of capsules were used at first, but after Fantus (5), Kirklin and Kendall (6), and Levyn and Aaron (7) introduced the liquid form of the dye, the capsule method was abandoned. At the end of 1931, a total of 534 patients had been examined by these methods, 207 of them by the intravenous, 268 by the oral route, and 41 by a combination of both methods.

INTRAVENOUS ADMINISTRATION

Moore (8) and Case (9) favor the intravenous administration of the dye in preference to the oral, for they are of the opinion that better absorption of the dye and less constitutional reaction are more likely to take place. In our series of 67 proved cases (12 also had the oral test), a correct diagnosis was made in 92.5 per cent. All the intravenous tests were carried out in the hospital. Of the cases pathologically diag-

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TABLE I

| Intravenous Cases | | | | Oral Cases | | |
|-------------------|-----------------|-------------------|--------------------|-----------------|-------------------|--------------------|
| Year | Number of Cases | Diagnosis Correct | Percentage Correct | Number of Cases | Diagnosis Correct | Percentage Correct |
| 1924 | 7 | 5 | 71.4 | 0 | .. | .... |
| 1925 | 1 | 1 | 100.0 | 4 | 4 | 100.0 |
| 1926 | 0 | .. | .... | 6 | 6 | 100.0 |
| 1927 | 3 | 3 | 100.0 | 1 | 0 | 0 |
| 1928 | 1 | 1 | 100.0 | 15 | 14 | 93.3 |
| 1929 | 6 | 5 | 83.8 | 11 | 11 | 100.0 |
| 1930 | 20 | 19 | 95.0 | 13 | 12 | 92.0 |
| 1931 | 29 | 28 | 96.5 | 9 | 9 | 100.0 |
| Total | 67 | 62 | 92.5 | 59 | 56 | 94.9 |

Note: Twelve cases had combined oral and intravenous tests.

nosed abnormal, 46 had cholecystitis, and of these 46 cases, 35 had stones in addition. The other types of proved cases consisted of a normal gall bladder with cholelithiasis, a case of carcinoma of the head of the pancreas with infiltration into the gall-bladder wall, a case of carcinoma of the head of the pancreas with marked metastases to the liver, a primary carcinoma of the gall bladder with stones, an atrophic portal cirrhosis of the liver, a metastatic carcinoma of the liver with a distended and tense gall bladder, and a ptosis of the gall bladder with pericholecystitis. Of the nine cases which were correctly diagnosed normal, at operation three showed no abdominal disease whatsoever and six showed various types of inflammatory lesions. Five cases were incorrectly diagnosed pre-operatively and showed a normal gall bladder without other evidence of abdominal disease, a duodenal ulcer, a case of hyperplasia of the mucous membrane of the gall bladder, a carcinoma of the stomach, and a mild cholecystitis with hypercholesteremia. In this last case, the oral test showed no visualization, whereas the intravenous test, done later, showed a good visualization with disappearance of the shadow after the fatty meal. Moore (8) calls attention to the fact that this type of

cholesterosis is one of the pitfalls in diagnosis.

ORAL ADMINISTRATION

According to Kirklin (10), the oral administration of the sodium salt of tetraiodophenolphthalein is as good a method as the intravenous for studying the function of the gall bladder. Since this method is simpler in most respects than the intravenous injection, it is routinely used at the Mayo Clinic. As shown in Table III, over 90 per cent of all the 869 operative cases were correctly diagnosed pre-operatively, and 98.2 per cent of the 505 diagnoses of abnormal condition were correct. This latter figure compares equally with that of Moore's (8) 406 cases tested intravenously with a correct pre-operative diagnosis of 98.77 per cent.

As shown in Table I, 59 cases came to operative or postmortem proof, and the diagnosis was accurate in 56 cases, or 94.9 per cent. In this group (as previously mentioned in the intravenous group), there were 12 cases which also had the intravenous test.

Of the cases diagnosed pathologically abnormal, 42 had cholecystitis and of these 42 cases, 33 had stones in addition. The other abnormal cases consisted of a primary

TABLE II.—INTRAVENOUS AND ORAL CASES

| Year | Number of Cases | Diagnosis Abnormal | Diagnosis Normal | Diagnosis Correct | Percentage Correct |
|-----------|-----------------|--------------------|------------------|-------------------|--------------------|
| 1924 | 7 | 6 | 1 | 5 | 71.4 |
| 1925 | 5 | 5 | 0 | 5 | 100.0 |
| 1926 | 6 | 4 | 2 | 6 | 100.0 |
| 1927 | 4 | 4 | 0 | 3 | 75.0 |
| 1928 | 16 | 15 | 1 | 15 | 93.7 |
| 1929 | 14 | 12 | 2 | 13 | 92.8 |
| 1930 | 28 | 25 | 3 | 27 | 96.4 |
| 1931 | 34 | 26 | 8 | 33 | 97.05 |
| Total | 114 | 97 | 17 | 107 | 93.8 |
| | | | | | |
| Diagnosis | | Correct Normal | | Correct Abnormal | |
| Normal | Abnormal | Number | Percentage | Number | Percentage |
| 17 | 97 | 15 | 88.2 | 92 | 94.8 |

carcinoma of the liver with metastases to the gall bladder and cystic duct, a carcinoma of the head of the pancreas in which the gall bladder was found large and firm, an atrophic cirrhosis of the liver, a case of sub-acute yellow atrophy of the liver, an adenocarcinoma of the gall bladder with stones, cholelithiasis with normal gall-bladder walls, an incarcerated calculus in the gall bladder, a metastatic carcinoma of the liver with a distended and tense gall bladder, and ptosis with pericholecystitis of a large gall bladder. There were five cases in this group which were correctly diagnosed as normal. One was a normal gall bladder with no other evidence of abdominal disease, one duodenal ulcer, a cystic ovary with a retroverted uterus, a chronic salpingitis, and a hydrosalpinx. Three cases that were incorrectly diagnosed consisted of a normal gall bladder with no other demonstrable disease, an involuted appendix, and a carcinoma of the stomach.

One case in this group, which was also mentioned under the intravenous group, is of particular interest in that it was correctly diagnosed by the oral and incorrectly by the intravenous test. The pathologic

diagnosis was a mild chronic cholecystitis and a hypercholesteremia. There was no visualization with the oral dye, but a good visualization with the intravenous and a disappearance of the shadow after the fatty meal. This divergence of response can be explained by the findings of Kirklin, Caylor, and Bollman (11) which showed that the concentrating ability of the gall bladder may be decreased or enhanced in cases of advanced disease. There may be impaired, normal, and hyperfunctioning areas. In this case, the intravenous test was probably "too good" or rather "too sensitive," and allowed the non-diseased parts to function enough to produce a good shadow.

COMBINED RESULTS

Table II shows all cases which came to operation or postmortem for check. In the first few years of the use of cholecystography, comparatively few cases were proved. Out of the total 114 cases over a period of eight years, 97 were diagnosed abnormal, 17 normal, and 107 (or 93.8 per cent) proved to be correct. Of the 97 cases diagnosed as abnormal, the correct diagnosis was obtained in 92 (or 94.8 per cent), and

TABLE III.—REPORTS OF SERIES OF OVER 100 PROVED CASES

| Author | Year | Number of Proved Cases | I. V. | Oral | Percentage Correct |
|-----------------------------|------|------------------------|-------|------|--------------------|
| Graham (12) | 1926 | 128 | 128 | .... | 96.4 |
| Graham (13), Moore (14) | 1927 | 147 | 147 | .... | 97.28 |
| Wilkie and Illingworth (15) | 1927 | 132 | 132 | .... | 88.0 |
| Case (16) | 1929 | 300 | 300 | .... | 92.5 |
| Kirklin (10) | 1929 | 869 | .... | 869 | 90.0 |
| Robins and Goldberg (17) | 1929 | 182 | .... | 182 | 86.2 |
| Johanneson (18) | 1929 | 100 | 100 | .... | 98.0 |
| Wilson (19) | 1930 | 135 | .... | 135 | 75.5 |
| Nordin (20) | 1931 | 281 | 281 | .... | 98.5 |
| Hawley (21) | 1931 | 146 | 78 | 68 | 90.4 |
| Moore (8) | 1931 | 406 | 406 | .... | 98.77 |

of the 17 cases diagnosed normal, 15 (or 88.2 per cent) were correct. One hundred and four cases were proved by operative check and ten by postmortem examination. Twelve of the 104 cases had laparotomies without removal of the gall bladder. Two of these cases had cholecystotomies in which many stones were removed, and in the other ten cases the diagnosis was obvious for abdominal conditions other than gall-bladder disease.

In Table III are listed a number of workers on cholecystography who have reported results in over a hundred proved cases. In general, it may be said that both methods are of great value and probably are of equal value in the diagnosis of gall-bladder dyscrasias, depending upon the individual technic and skill of the roentgenologist. There are many factors which make for good or poor results, and each one, from the instructions to the patient to the interpretation of the films, plays a great part in the success or failure in the accuracy of diagnosis.

PITFALLS IN DIAGNOSIS

Aside from methods of technic and from the fact that patients may not carry out their instructions properly, mistakes can be

unwittingly made by the roentgenologist because of certain confusing shadows on the films. LeWald (22) has reported cases of "spontaneous inspissation" of bile which casts a shadow not unlike that of a normal gall-bladder visualization. Cross (23) has described a case sent to him for cholecystographic examination in which the preliminary film showed a gall-bladder shadow denser than the average cholecystogram. At operation, a greenish "mud" was found in the gall bladder which was composed of cholesterol, calcium carbonate, and phosphate. Brailsford (24) cites two cases in which the preliminary film showed gall-bladder shadows as normal-looking cholecystograms because the organ was found to be filled with what he termed "sand." In this type of case, the function of the gall bladder is impaired, but may be overlooked by the roentgenologist. The persistence of the shadow without change in size after a fatty meal would give the clue to a pathologic diagnosis. These cases are not cited to indicate the necessity for a routine preliminary film of the abdomen. Many institutions still follow this practice, but here it is felt that it is an economic waste. Large, faintly visualized gall bladders may be considered abnormal by their

appearance on the roentgenogram and yet be found at operation to be normal. Formerly, it had been our practice to repeat the examination in all types of faintly visualized gall bladders, and, if the same type of shadow appeared on the second series, the gall-bladder function was considered abnormal. But since this survey has been made, this practice has been discontinued. However, if the technic was unsatisfactory, the examination was repeated. Out of 23 proved cases that had a second test, only three showed a discrepancy; two of these were due to technical difficulties, one because the film was taken poorly and the other because only one-half the proper amount of dye was injected. Thus, only one case out of 23 (or 4.3 per cent) showed an actual discrepancy. This case, which was pathologically diagnosed hypercholesteremia, has been referred to previously. Thus, cholesterosis may be present without obvious cholecystographic signs. In a certain percentage of gall bladders which visualize normally, we, as other observers, have found that a diseased organ may exist. The explanation by Kirklin, Caylor, and Bollman (11) for this finding has already been mentioned. Slight mottling in a well visualized organ very often presents a borderline case. This mottling may be due to slight movement of the patient during the exposure, or it may be due to multiple stones.

While the cases presented show that cholecystography is of great value in the confirmation of clinical diagnoses of the gall bladder, it must be remembered that this test is not foolproof. It represents a test only of the concentrating ability of the gall bladder. In the excellent study on the concentration of cholecystographic mediums and bilirubin by the gall bladder, Kirklin, Caylor, and Bollman (11) state that, "in view of the results of this study it would appear that, while cholecystography is a reliable test of the function of the gall bladder, dependence on it as a diagnostic meas-

ure should not be encouraged to the exclusion of older clinical methods." Eusterman (25) strongly emphasizes that the roentgenologist should not play the part of the diagnostician. Only by close co-operation between clinician and roentgenologist can the most accurate diagnosis be made.

CONCLUSIONS

1. Cholecystography, although a well established procedure in gall-bladder diagnosis, should be studied more to obviate the existing difficulties.
2. Both intravenous and oral methods should be employed.
3. Review of the literature, as well as our own statistics, show that the intravenous and oral methods of administration are of about equal value in gall-bladder diagnosis.
4. Experience at the Cleveland City Hospital shows a correct diagnosis of 92.5 per cent with the intravenous and 94.9 per cent with the oral method. The average correct diagnosis is 93.8 per cent.
5. Cholecystography is a reliable test of gall-bladder function.
6. The roentgenologist must be on the lookout for pitfalls in diagnosis with this procedure.
7. Co-operation between clinician and roentgenologist is necessary for accurate gall-bladder diagnosis.

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A STUDY OF THE MOTOR PHENOMENON OF THE MEDIASTINUM IN INFANTS AND CHILDREN

WITH PARTICULAR REFERENCE TO HYPERPLASIA OF THE THYMUS¹

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WHILE "thymic hypertrophy" has been and still is a frequent roentgenologic diagnosis, studies in the motor phenomenon of the mediastinum during the last three years have proven that such a diagnosis is often an erroneous one. In fact, experimental observations of the mediastinal physiologic movement with the Jarre cinex camera tend to prove convincingly that thymic hyperplasia, *per se*, is rather infrequent. Yet thymic hypertrophy does exist. Postmortem examinations have demonstrated slight to great enlargement

beyond the peradventure of doubt. How, then, can a roentgenologic examination be conducted to either confirm or rule out a possible hyperplasia of the thymus? Is it possible to demonstrate slight thymic hyperplasia? Does it ever exist without symptoms? Are the symptoms—cyanosis, respiratory stridor, convulsions, etc.—caused by other pathologic conditions? These, and a host of other questions, should be asked and satisfactorily answered, if they can be, before one is entitled to become too dogmatic in expounding theories.

This paper is by no means a final analysis of so complex a subject as thymic hyper-

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plasia, but is offered to stimulate a definite routine in the examination, and to encourage—yes, to urge—the use of the fluoroscope in making the study. An examination of an infant's or a child's chest should

physiological changes and by no means indicate pathology. A wide supracardiac mediastinal shadow does not necessarily imply that the thymus is of increased size. In the past, such an interpretation of a wide medi-

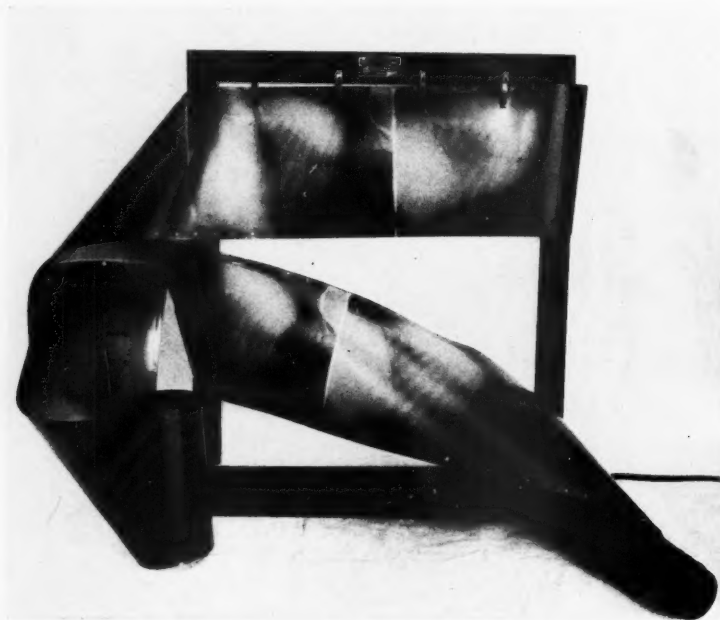


Fig. 1. Roll film showing multiple records of the motor movement of the trachea incident to forced breathing. Rate of exposure about three to four per second. The outline of the trachea is retouched.

never be considered complete without thorough fluoroscopic study in both the anteroposterior and lateral positions. Special emphasis should be placed on observation of the lumen of the trachea, not only during the entire phase of inspiration and expiration, but particularly at the height of inspiration. With the Jarre cinex camera it is possible to record the physiological changes in the movement of the mediastinum on a permanent film which can be traced, studied, analyzed, and discussed at leisure. The method of analysis will be explained later. It has been shown that some of the changes in the position and size of the lumen of the trachea, as well as the changes in the cardiac outline, are motor

astinal shadow led to the very common interpretation of thymic hyperplasia. Roentgenologists have been too anxious perhaps to find something on the examination which might explain, by the remotest chance, the clinical picture and, hence, any prominence of the mediastinal shadow in any phase of respiration or cardiac cycle has been erroneously advanced as indicating thymic enlargement. Normal physiologic movements must be taken into consideration before a positive diagnosis of thymic hypertrophy can be made from a roentgen-ray study; yet one should always bear in mind the possibility of an increased thickness of the thymus or anteroposterior thymic hypertrophy.

One might ask for the "nth" time, What

is thymic death? Can there be a thymic death without any enlargement of the thymus? Is the enlarged thymus associated with a constitutional defect commonly called, in medical literature, a status lym-

blood vessels, and nerves, thereby producing in many cases asphyxia and death.

The second theory, probably advanced at first by Paltauf and more recently supported by Warthin and many other pathol-



Fig. 2. Film of chest and nasopharynx made at the height of inspiration. The lung tissue is expanded. The trachea shows no evidence of compression or buckling. Note the foreign body shadow in the nasopharynx.



Fig. 3. Same patient as shown in Figure 2, taken at the height of expiration. Note the density of the lung tissue and the buckling of the trachea. There is no evidence of thymic hypertrophy.

phaticus, or a status thymico-lymphaticus? These questions have not been satisfactorily answered even though they have been controversial subjects for many decades. However, the arguments and heated debates which have resulted have been fruitful: they have stimulated and are continuing to stimulate further research among radiologists, pathologists, and pediatricians.

Marine, in 1928, summarized the various theories of thymic death. The radiologist is interested particularly in the first theory, namely, the so-called obstructive theory, which, according to some investigators, results in mechanical pressure on the trachea,

ogists, ascribes death to a constitutional defect associated with hyperplasia of the thymus which involves both the cortex and the medulla but especially the medulla, as well as a general lymphoid hyperplasia and a marked hypoplasia of the adrenals and the cardiovascular system. A third theory is anaphylaxis. A fourth theory ascribes death to an excessive and abnormal thymic secretion which results in a lympho-toxemia. A fifth theory suggests that death might be due to a hypersusceptibility to a physical and chemical agent.

Pancoast, by careful and painstaking fluoroscopic observations, has contributed in

two publications a great amount of information on the mechanical obstruction theory. He conducted experimental studies in both the horizontal and vertical positions, obtaining films as nearly as possible at the height

THE METHOD OF EXAMINATION AND STUDY

The Jarre cinex camera is in reality an enlarged edition of an Eastman kodak. A roll film approximately twenty feet in length

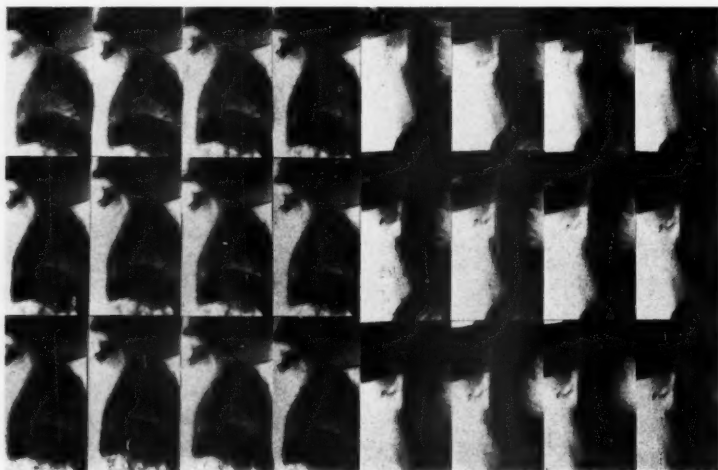


Fig. 4 (left). Multiple exposures selected from one roll of film. Note the variation in the density of the lung tissue. Patient in the lateral position.

Fig. 5 (right). Multiple exposures of the cervical region on an adult shown here to emphasize the change in the outline of the trachea due to normal inspiration and expiration.

of inspiration and expiration. During the examination the child's head was held straight, midway between flexion and extension and without rotation. Exposures were made after inducing the patient to cry lustily.

Our examinations with the Jarre cinex camera have been conducted with the patient in the horizontal and lateral positions and, like those of Pancoast, include the study of the nasal pharynx as well as the neck and the chest. Fluoroscopic observations have been made with the child in the vertical position, but as yet we have been unable to obtain any roll films demonstrating the physiological movement in the upright position. We hope to be able to make these observations for comparative study in the near future.

is usually used, and exposures may be made slowly or rapidly, it being possible to maintain a maximum rate of from three to four exposures per second. Some of the rolls on the study of the thymus were actually made in from ten to eleven seconds. On such a film there is a record of the movement of the heart in diastole and in systole; the chest in inspiration and expiration, as well as in many of the intermediate phases. Some of the films were made in the antero-posterior position, others in the postero-anterior position, and still others in the lateral position with the arms and shoulders placed posteriorly. Some were made with the arms drawn up above the head. We have found that the Pancoast method in the lateral position is the most satisfactory, as the entire lumen of the trachea, the nasal

pharynx, and the oropharynx can be studied. After the roll film was developed and dried, tracings of the thoracic cage, the heart, trachea, larynx, tongue, and bony landmarks were made in consecutive order on trans-

The most striking observation from this study was the mediastinal shift in the lateral position, at times to the right and then to the left, the shift occurring without any particular rhythm: later an anteroposterior

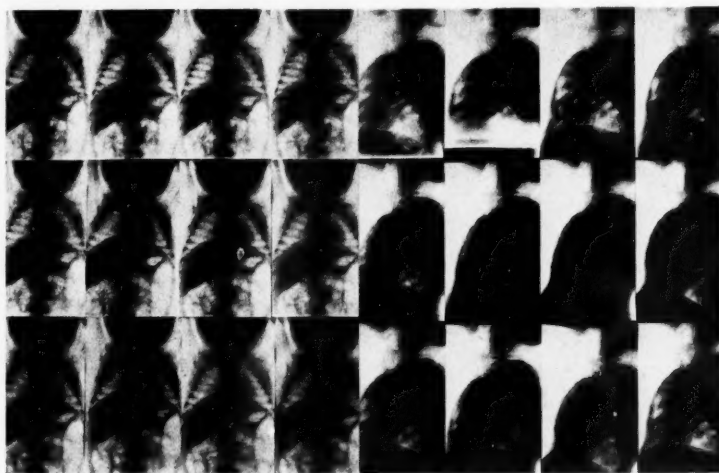


Fig. 6 (left). Multiple exposures in the anteroposterior direction. The individual exposures were selected at random from one roll of film.

Fig. 7 (right). Method of study: Note the tracing of the outline of the trachea, cervical vertebrae, diaphragm, heart, etc.

parent paper. These tracings are, in reality, animated drawings and were then studied by superimposing one on another so that the minutest movement could be detected, the bony landmarks closest to the films being used as points of fixity for the animated drawings. In one of the cases, over a hundred animated drawings were made whereupon, on superimposing one on the other, it was found that no two were identical in every phase: some were similar while others were greatly dissimilar. This is a significant finding and definitely proves that films before and after treatment are absolutely worthless and should never be used except for relative comparison. The outlines were disturbed by the cardiac cycle, the respiratory cycle, and other factors such as the emotional state of the patient, movement of the liver, etc.

shift was noted. Then, is it not correct to assume that there possibly is a circular or perhaps an oval type of shifting of the mediastinum? Either engorgement of the large vessels or lack of an excessive amount of blood within them was responsible for some of the cardiac mediastinal prominence or the lack of it. On some of the films we noted that the trachea was carried to one side, corresponding to the shift of the mediastinum, and that there was also a corresponding shift of the trachea in the cervical region.

A special study was made to note the narrowing of the cervical trachea. This was found usually at or near the height of inspiration or during the time when the full length of the trachea was needed. There apparently is a physiologic narrowing of the trachea, in no way associated with pressure from an enlarged thymus, which is

probably Nature's way of stretching a tube, which, for a fraction of a second, would be too short if it were not for the elastic tissue and its ability to be stretched. This theory is borne out by the fact that anatomists

upwards and that it is pressed into the bony thoracic inlet, thereby producing sufficient pressure on the trachea, the blood vessels, and the superior laryngeal nerve to produce a mechanical death. It has never been sat-

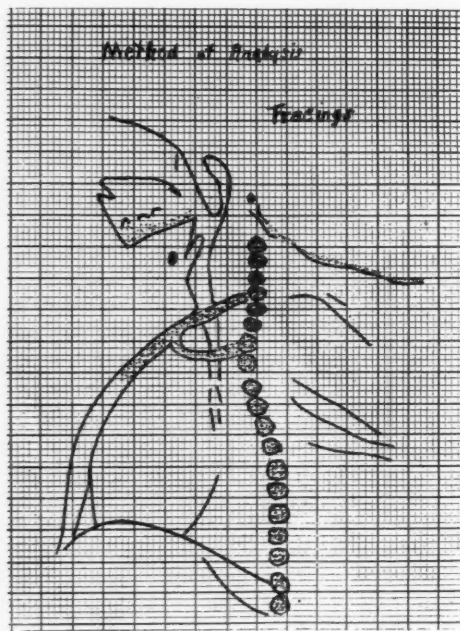


Fig. 8. Method of analysis: Tracing from a roll of film. Compare with Figure 9.

state, in describing the larynx and trachea, that the "fibrous membranes are highly elastic" and, "beneath the mucous membrane of the larynx is a broad sheet of fibrous tissue containing many elastic fibers."

Those who give their support to the so-called mechanical obstructive theory agree with the anatomical studies of Noback, who emphasizes the pyramidal shape of the thymus, with the base of the gland below the level of the clavicle. Further support is found for this theory in the rigid thoracic inlet and the fact that the cartilaginous rings of the trachea are incomplete, being absent posteriorly. They are of the opinion that during expiration the thymus is pushed

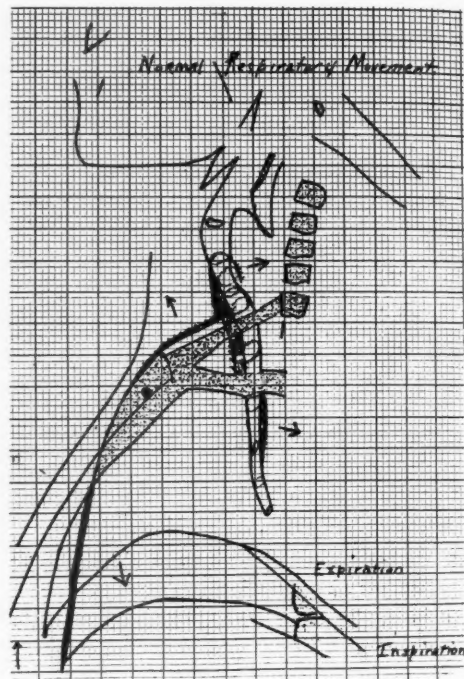


Fig. 9. Tracing of two exposures from a single roll of film, showing the movement of the diaphragm, thoracic cage, and trachea incident to breathing. The slightest movement is detected by this method of study. In fact, the mediastinal shift in both the anteroposterior and lateral positions was demonstrated in this way. This method of study has proven that some of the buckling and narrowing of the trachea is part of the normal motor phenomenon.

isfactorily proven that death actually results from thymic compression alone, though many are still of the opinion that it does happen. We believe that compression and pressure are factors which are not to be too lightly considered and, furthermore, the thymic gland may enlarge still more from edema or perhaps internal hemorrhage, and it may even buckle on itself. However, partial obstruction is by no means a com-

plete one, and if it were not for a constitutional defect, the obstruction alone would be insufficient to cause asphyxia and death. In other words, thymic death is due to something more than mechanical pressure from a hypertrophic gland, and, if we may repeat for emphasis, that something is the constitutional defect. Our studies of normal chests and others have shown that at times there is a buckling in the trachea which we are inclined to regard as being physiologic, explained by the fact that during expiration the contractile powers of the trachea and larynx are not sufficient to straighten the trachea and that for a given fraction of a second it is in reality too long. Nature has taken care of the added length by buckling or bending it; hence, we are inclined to believe that some of the buckling should not be taken as direct evidence of pressure. Slight buckling represents one phase at the height of expiration, while definite stretching and constriction represent the opposite phase, that is, the height of inspiration. It is the excessive amount of buckling and constriction which actually represents possible thymic enlargement. In addition to intermittent narrowing of the trachea at the thymic inlet, we have also noticed narrowing at the lower portion of the trachea. We attempt to explain some of this by the reports of Hudson and Jarre who, when iodized oil was introduced into the bronchus, demonstrated physiologic wave-like motion in the trachea and in the bronchi, which are probably comparable to the peristaltic waves of the intestines.

Kennedy and New recently emphasized the fact that chronic stridor has frequently been ascribed to enlarged thymus when, on further study, other pathologic conditions were discovered such as (1) congenital relaxation of the larynx; (2) congenital atony of the larynx; (3) congenital atony of the vocal cords; (4) stridor due to cerebral origin; (5) bilateral abductor paralysis;

(6) neoplasms; (7) tetany; (8) subglottic diaphragm; (9) tumors of the thymus (rare); (10) lingual thyroid gland; (11) retropharyngeal abscesses; (12) congenital flaccid tongue. There are a host of other conditions producing symptoms which a supposedly enlarged thymus produces, of which atelectasis, stenosis of the trachea or larynx due to infection, congenital heart condition, whooping cough, meningitis, etc., are the most common.

THYMIC HYPERTROPHY AS OBSERVED WITH THE JARRE CINEX CAMERA

The most constant roentgen sign in the cases which we have studied by the Jarre cinex camera method, showing definite thymic hypertrophy, is a constant lobation as demonstrated in the prone position. A constant lateral deviation of the trachea, with more or less constant buckling, would indicate pressure, probably from the thymus. Too much emphasis must not be placed upon slight buckling of the trachea at the thoracic inlet excepting when it can be repeatedly demonstrated and remains more or less constant in the identical position. We are inclined to regard some buckling and some constriction as physiological changes and not definitely indicating the presence of an enlarged thymus. Borderline cases are indeed hard to eliminate even with a thorough and elaborate x-ray examination. Because of this fact, we should like to emphasize the necessity of teamwork in establishing the borderline cases of thymic hypertrophy. In some of them, we feel that a bronchoscopic examination is necessary to eliminate other conditions caused by a moderately enlarged thymus which might produce the same symptoms. If the question of therapy is a pressing one, it is perfectly justifiable to administer x-ray therapy over the thymic area if some narrowing of the trachea at the thoracic inlet has been demonstrated at the height of inspiration. It is not necessary to administer a heavy dose, since symptoms are

readily ameliorated by fractional, filtered, extremely small x-ray treatments. It is not our intention to enter into theories to explain the beneficial result following x-ray therapy except to mention that we do believe it is not due entirely to the diminution in the size of the gland. The so-called protein theory is interesting.

CONCLUSIONS

Thymic hypertrophy does occur, but its incidence is rather infrequent. The degree of the hypertrophy varies. It is probable that complete mechanical obstruction of the trachea is a myth. Constant lobation, constant displacement of the trachea, intermittent pressure on the trachea, noted particularly at the height of inspiration, indicate varying degrees of thymic hypertrophy. To eliminate the possibility of other intrathoracic pathology, routine x-ray examination of the chest is advocated.

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CASE REPORTS AND NEW DEVICES

A RICE PHANTOM FOR DEPTH DOSE MEASUREMENTS

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It is our purpose in this article to describe a simple method of making depth dose determinations.

In order to apply radiation scientifically, it is necessary that the roentgenologist know, as precisely as possible, the characteristics of the radiation being employed. There are two factors, which, when known, completely define the x-ray beam. One of these is "intensity," or "quantity per unit of time," and the other is "quality," or "hard-

ness," or "penetration." The unit of intensity or quantity has now been universally adopted as the international roentgen, or r unit. A suitable unit of hardness or penetration—the penetration depends upon the wave length—has not yet been adopted. At the present time there are four general methods for determining hardness or penetration: (a) spectroscopic determination, (b) effective wave length measurement, (c) half value layer, and (d) depth dose.

There are several disadvantages in the use of any of the first three methods, the principal one being that the end-result gives nothing of practical use to the roentgenologist. For instance, an effective wave length determination under a certain set of condi-

tions may give a value of 0.165 Ångstrom unit. What does this mean to the average roentgenologist? Supposing that, instead

The half value layer, the most common method used in European clinics and laboratories for the determination of hardness or

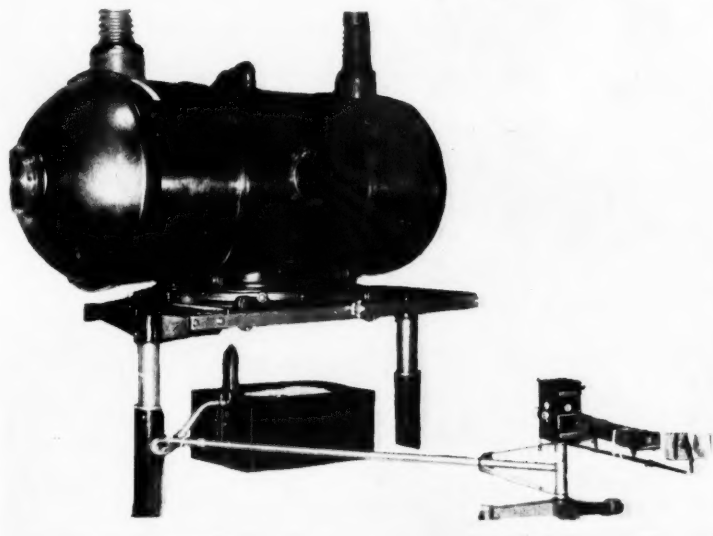


Fig. 1. Rice phantom under drum containing x-ray tube, with ionization chamber of dosimeter in place.

of 0.165 Å., the result was 0.160 Å.—what of it? What use can he make of it?

The spectroscopic method is, in general, only applicable in the research laboratory or by a highly trained physicist, and these measurements, difficult as they are to make, are not readily translated into terms of roentgentherapy.

The effective wave length method of determining penetration is not as easily determined as the directions for making this test would lead one to believe, and slight experimental errors will completely vitiate the results. Unless the work is done by a competent worker, with a large number of readings, results bordering on the absurd are likely to occur. The same experimental errors which may have a disastrous effect on effective wave length determinations will cause small changes in the final results of actual depth dose measurements.

penetration, if carried out properly with repeated ionization measurements (the photographic method is not reliable) is, indeed, a laborious procedure, and, as in the case of the other two methods cited above, is not readily translated into terms of practical deep x-ray therapy.

In contrast to these rather indirect methods, the depth dose determination is simple, direct, and understandable by the practising roentgen therapist. A reading, showing that 42 per cent of the radiation absorbed at the surface is absorbed in a lesion 10 centimeters deep, gives direct workable information.

The ideal object for use to determine depth dose measurements would, of course, be the human body. However, except under certain restricted conditions, this is not practicable; hence, we must use a substance to replace the body which has approximately

the same absorption. Water has been used for this purpose for many years, and, while from the standpoint of absorption it is ideal, for its opacity to radiation is practically the same as that of tissue, yet the disadvantages

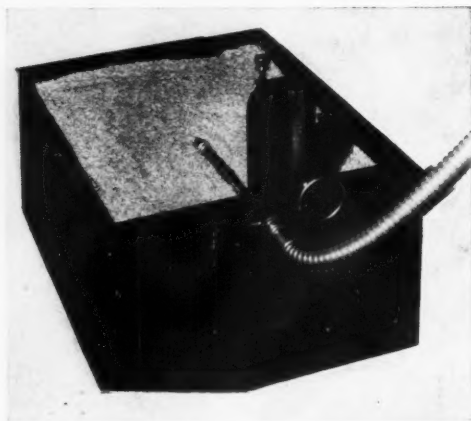


Fig. 2. Rice phantom showing chamber of dosimeter half buried in rice.

of using it are, first, its general sloppiness, and second, the great danger of getting it into the ionization chamber of the measuring instrument. It would be of considerably greater convenience if a dry substance could be used. Paraffin has been widely employed, therefore, despite the fact that it is some 15 per cent less absorbent than water. This, to our mind, constitutes a serious disadvantage. In addition, accurately dimensioned paraffin blocks are hard to make and to preserve.

In a personal communication to one of us (R. T. P.), Prof. Holfelder, Director of Roentgentherapy at the University of Frankfort, Germany, mentioned that he used ordinary polished rice to fill in the hollows of the body, when giving deep therapy treatments. The purpose of the rice is to give better distribution to the radiation. Prof. Holfelder mentioned also the fact that loosely packed rice has practically the same absorption coefficient as body tissue.

Some time ago, we constructed a phantom

for the use of rice instead of water in depth dose determinations which has proven remarkably satisfactory. Before describing the phantom itself, we will give the comparative measurements with rice and water.

The determinations were made using a mechanically rectified machine, 8 milliamperes of current, 50 centimeter target-phantom distance, 180 peak kilovolts, 20 by 20 centimeter field, and a filter composed of copper, tin, and aluminum (modified Thoraeus)—an equivalent of 2 millimeters of copper.

Let I_{ow} represent the radiation intensity at the surface of the water.

I_{10w} intensity 10 cm. deep in water.

I_{or} intensity at surface of rice.

I_{10r} intensity 10 cm. deep in rice.

Our experimental results were as follows:

$I_{ow} = 23.2$ r per minute. $I_{10w} = 10.6$ r per minute.

$$\frac{I_{10w}}{I_{ow}} = 0.457 \text{ (45.7 per cent depth dose in water).}$$

$I_{or} = 23.5$ r per minute. $I_{10r} = 11.0$ r per minute.

$$\frac{I_{10r}}{I_{or}} = 0.468 \text{ (46.8 per cent depth dose in rice).}$$

These results show that rice absorbs approximately 2 per cent less than water, a difference which in contrast to paraffin may be neglected from a practical standpoint. These results also show that the back-scatter from rice is within 1 per cent of the back-scatter from water. Thus, evidently, rice may be substituted for water as it has similar absorption characteristics.

The phantom (Figs. 1 and 2) consists of a wooden box without a top, approximately 13 inches square by 10 inches deep. One end is fitted with an ingenious gear-driven slide mechanism for holding and moving the ionization chamber. To operate the apparatus, the ionization chamber is clamped into place, adjusted by means of the hand wheel

until it is half buried in the surface of the rice, and ionization readings are taken with the chamber in this position. It is then lowered through the rice to the desired position by simply turning the hand wheel, the rice being so loose that the chamber readily slips through it; in fact, the chamber moves almost as easily through the rice as it would through water. This is one of the most advantageous features of the rice phantom, as it enables the operator to obtain readings at any desired depth. The rice used is ordinary commercial polished rice, costing about four cents a pound (wholesale), approximately forty pounds being required. The rice is simply poured into the phantom and leveled off with a knife or spatula.

AN APPARATUS FOR THE PRODUCTION OF LOCAL HEAT IN BODY TISSUE BY MEANS OF HIGH FREQUENCY ELECTRIC FIELDS

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Diathermy machines, infra-red radiation, hot compresses, etc., have been used for many years for the production of heat in local parts of the body in the treatment of disease, particularly arthritis. In the case of heating lamps, the penetration of heat is so slight that the temperature of the deep parts is not appreciably raised. In cases in which heat is transmitted by conduction, as in hot compresses, the dissipation of heat by blood flow through the part treated makes it impossible to administer heat to the deep structures. With diathermy machines, in a case in which a high frequency current is passed through the part by means of electrodes directly applied to the skin, there is produced a through-and-through heating, and such

machines have sufficient power to overcome the dissipation of heat by blood flow, etc., and to maintain the elevated temperature of the part as long as desired. However, it is difficult at times to attach electrodes to certain parts of the patient, such as the shoulders, and there are certain difficulties in securing good contact with the skin.

Through recent advances in the radio field it has become possible to apply energy to a part of the body and cause a rise of temperature in the tissues without an actual application of electrodes; in other words, we now have an apparatus at our disposal which retains the advantages of a diathermy machine as far as deep heating is concerned, but with many of the disadvantages eliminated. It can be constructed in any well equipped laboratory and need not then cost more than an ordinary diathermy machine. Carpenter and Page (1) describe a radio apparatus of high power for the raising of the systemic temperature. Pätzold (2) describes a lower powered machine for the local application of this form of energy. However, no circuit and but few data are given. We propose to describe in detail an apparatus constructed in this laboratory and which has been applied clinically for some time with good results.

If the essential circuit requirements are complied with, there is considerable latitude in the arrangement and design of the apparatus, as well as the manner of application of the energy to the patient.

The machine consists essentially of a high frequency vacuum tube oscillator, operating at a frequency of about 10,000 kilocycles. The output of the machine is led to two insulated plates between which the part of the body to be treated is placed. An intense, rapidly fluctuating, electrostatic field exists between these plates, and the heating effects are brought about by electrical losses, such as dielectric hysteresis and eddy current losses, occurring in the part of the body under treatment.

The principal circuit (Fig. 1) is essentially that of a short wave radio transmitter. Two UX 852 radiotrons, rated at 75 watts

pack. A tapped iron-core inductance is connected in series with the primary winding of the step-up transformer as a control of input

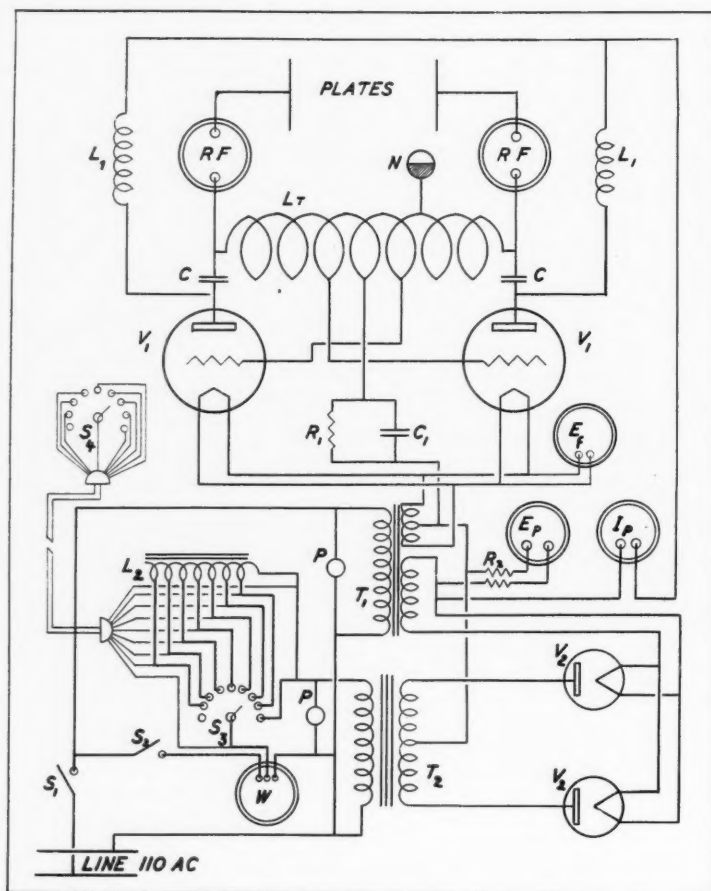


Fig. 1. Wiring diagram of apparatus. *Definitions of Symbols:* L_T , Tank inductance of oscillator; L_1 , Radio frequency chokes; L_2 , Variable input choke for voltage control of plate transformer; C , 0.002 mfd blocking condenser, rating 5,000 volts; C_1 , 0.002 mfd by-pass condenser, rating 1,000 volts; T_1 , Filament transformer, one 10-volt winding, one 2.5-volt winding, 5,000-volt insulation; T_2 , Plate voltage transformer, 2,500-0-2,500 volts; R_1 , 10,000 ohms, 50-watt grid leak; R_2 , Two 500,000-ohm resistors, used as multipliers for voltmeter; I_p , Plate current milliammeter, 0-500 ma.; E_p , Plate voltmeter, 0-3,000 v.; E_f , Filament voltmeter, 0-10 v.; W , Wattmeter in primary of plate transformer, 0-750 watts; RF , Radio frequency ammeter, 0-5 amps.; N , Neon RF indicator lamp; P , Pilot lights across primaries of power transformers; V_1 , UX 852 RCA radiotron; V_2 , UX 866 RCA radiotron; S_1 , Filament transformer switch; S_2 , Plate transformer switch; S_3 , Voltage control switch for plate transformer; S_4 , Remote control switch, same purpose as S_3 .

each, are connected in a push-pull Hartley circuit. The tubes are energized by a 2,000-volt, full wave rectified but unfiltered, power

voltage to the radiotrons. Two UX 866 mercury vapor tubes act as rectifiers for the high voltage. The filaments of all tubes are

fed by a single separate filament transformer.

The wattmeter, the high tension volt-

ed to the frequency range used by cut-and-try methods. The leads from the tapped primary choke coil go to the nine-point

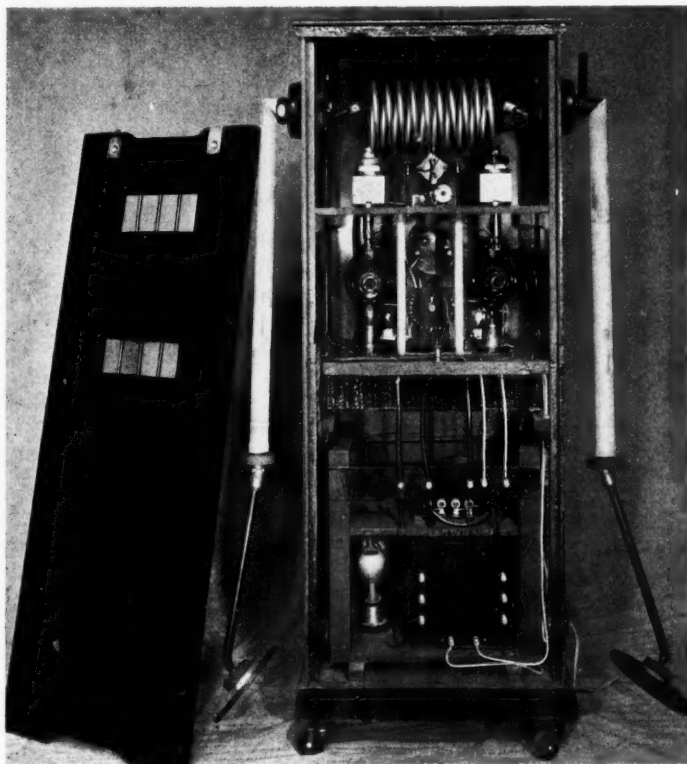


Fig. 2. Layout of parts as seen from the rear.

meter, and the filament voltmeter, and perhaps the radio frequency ammeters, are not absolutely essential but add greatly to the ease of the adjustments of the apparatus and are valuable for the collection of data. The plate milliammeter is quite necessary as an indicator for the correct operation of the machine. One terminal of a one-half watt neon lamp is attached to a low voltage point in the radio frequency circuit to act as an oscillation indicator. A choke coil is placed in the plate circuit of each radiotron to prevent the radio frequency currents from feeding back into the power pack. These may be wound in the laboratory and adjust-

switch on the panel and also to a multipole socket, so that by means of a nine-point plug the machine may be operated by remote control at another rotary switch at the end of a small nine-wire cable.

The cabinet may be of any size and shape that allow free access to the apparatus and an easy application of the energy to the patient (Fig. 2). Our cabinet was adapted from an old high frequency machine. It stands 130 cm. high, 45 cm. wide, and 40 cm. deep. The upper front of the cabinet holds a 1-cm. thick rubber panel, 60 cm. high and 40 cm. wide. Upon this panel are mounted all meters and controls.

The radio frequency voltages are led to the treatment plates by two jointed and extensible arms, the "shoulder joints" of

8-mm. brass rod 35 cm. long, capable of complete rotation. This is insulated by hard rubber. The "wrist" consists of a 2.5-cm.

ball-and-socket to which the treatment plate is attached. The usual treatment plates consist of circular aluminum discs, 1 mm. thick and 16 cm. in diameter, encased in hard rubber. These plates are interchangeable with a smaller elliptical pair, with a major and minor axis of 11 cm. and 7 cm., respectively. Because of the ample extensibility of the arms and the flexibility of adjustment, patients may be treated readily while lying in bed (Fig. 4). The length of the arms may be varied from about 1 meter to 1 meter 60 centimeters. In application, the plates are adjusted one to each side of the part to be treated, with a space of from 2 to 4 cm. between the plates and the skin. This technic permits easy observation of the condition of the skin, which may be injured, as in ordinary diathermy, if too great power be used.

DISCUSSION

For low power work a single oscillator tube could be used. However, in such a case one of the treatment plates would be connected to the grid end of the he-

lix, and, if much power were absorbed, the tube might cease to oscillate. In general, the push-pull arrangement is more satisfactory. Self-rectification is not advisable because the oscillator tubes become too hot. A frequency of about 10,000 kilocycles (30 meters) has been chosen because the tubes oscillate readily and deliver ample power at these frequencies. There is, naturally, a frequency shift when the length of the arms or the spacing of the treatment discs is altered, or

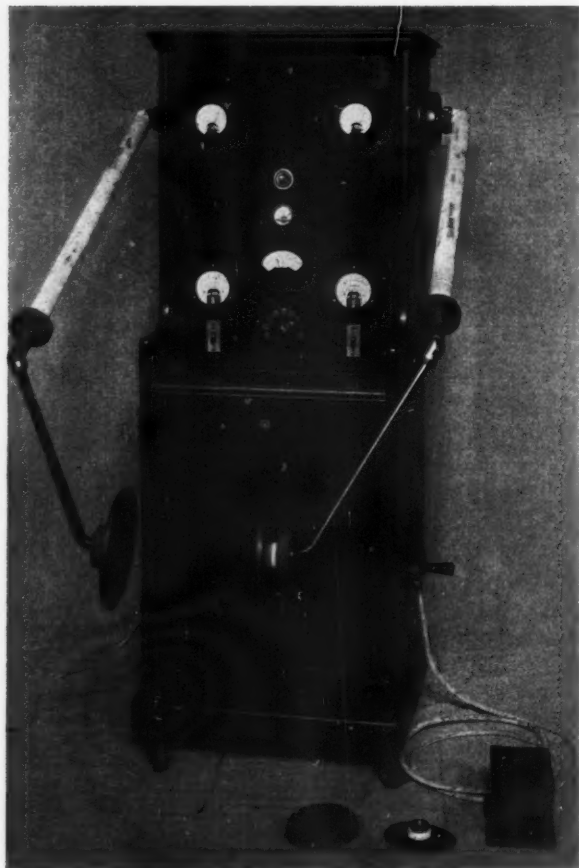


Fig. 3. Showing attachment of arms and multiple joints. Front view of cabinet.

which (Fig. 3) are attached to the cabinet sides at a height of about 120 cm. from the floor. The "upper arm" consists of a 70-cm. length of 2.5-cm. brass tubing, with a 60-cm. length of smaller tubing which just slides easily inside of the larger one. A clamp at the end of the outside tubing holds the sliding portion in any desired position. The "elbow joint" is attached to the lower end of the sliding portion of the upper arm. There is a "forearm" consisting of an

when a patient is placed between the electrodes. This variation is of little consequence, since these relatively small changes

patient is simpler than in the case of "electrode" diathermy, and is much less time-consuming.

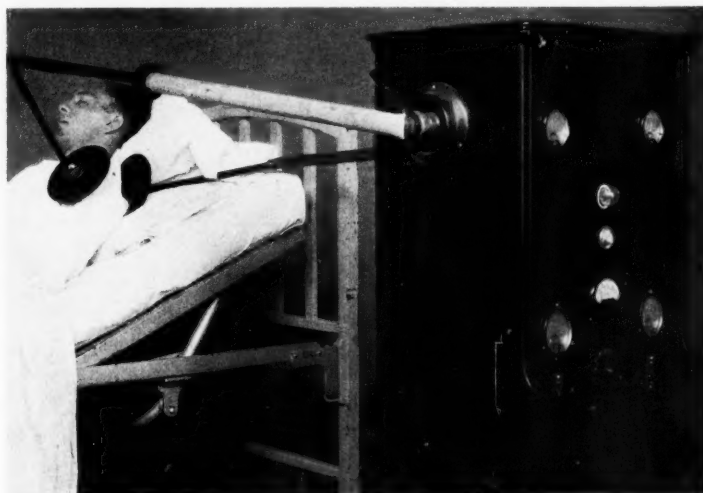


Fig. 4. Illustrating the method of applying the electrostatic field to a bed patient.

of frequency at this wave length have little or no effect upon the heating produced. The arms are insulated as much as possible to avoid burns, which would occur if an exposed part of the high frequency circuit were touched.

Not a great deal is known about the temperature gradients occurring in tissue treated by this method, because of difficulties in using thermo-couples, etc., in a very high frequency field, but it is generally believed that they are quite similar to those found in ordinary diathermy. The clinical results do not seem essentially different.

CONCLUSIONS

An apparatus, capable of producing extremely high frequency oscillations, has been described, the electric field of which is utilized to produce heat in local parts of the body. The application of this energy to a

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DIVERTICULA OF THE DUODENUM

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Since Chomel, in 1710, first described a diverticulum arising from the duodenum, until 1911, less than a hundred cases have been reported in the literature. J. T. Case, in 1913, was the first to call attention to the diagnosis of duodenal diverticula by means of the roentgen ray and the opaque meal. Since that time, new cases have been reported in increasing numbers. With few exceptions, the papers written on the subject are either reports of single cases, or deal with

the x-ray diagnosis rather than with the subject as a clinical entity. This is due, no doubt, to the fact that many cases of duodenal diverticula are found accidentally, either by x-ray or autopsy, and apparently gave rise to no symptoms. Spriggs (21), however, in a report of 38 cases, found definite abdominal symptoms which could be attributed to no other cause in 18 of the 38, or almost 50 per cent.

Pathology and Etiology.—Diverticula have been classified into acquired or congenital.

As to etiology, one is faced by many theories. Cole (9) lists four opinions of causation, as follows: (1) That diverticula are congenital in nature, representing abortive attempts at the formation of supernumerary pancreas; (2) that they may be caused by traction from without, by gall-bladder disease, etc.; (3) that they may be localized defects in the muscularis, with pouching resulting from age; (4) that they may be caused by pressure from partial obstruction below, with resultant localized herniations.

It is quite obvious from the above list, in addition to several other theories, that a suitable explanation which will fit all cases has not yet been found.

Diagnosis.—There is as yet no symptom-complex by which a duodenal diverticulum can be recognized clinically; hence, the diagnosis rests entirely upon the x-ray and the opaque meal. Case has described the roentgen findings; briefly, they are: A more or less spherical shadow situated on the concave side of the duodenum; separate from, yet related to, the duodenum. Persistence of the shadow after the stomach and duodenum are empty—it may persist for several hours or even days. There is usually no tenderness directly localized over the shadow; however, in the series herein reported there was definitely localized tenderness in five of the twenty cases.

Last, but not least, the most important

part of the gastric examination is to look intensively for diverticula. On the film it is possible that barium-filled diverticula may be confused with such other conditions as calcified glands, biliary or renal stones, colonic haustrations, perforated gastric or duodenal ulcers, or dilatations of the ampulla of Vater (the third group listed above). Careful fluoroscopic examination and progress films, however, usually reveal the true nature of the shadow.

Incidence.—In the writer's last 1,978 consecutive gastric examinations duodenal diverticula have been observed in 20 cases (approximately 1 per cent). In 19, the pouch was single; in one, there were two pouches. The locations of the 21 diverticula were as follows: one in the first part of the duodenum; 12 in the second part; seven in the third part, and one in the fourth part. The size of the pouch varied from 1 to 9 cm. in diameter. The average age of the patients was 52 years, the oldest being 71, and the youngest 31. Nine were males, and 11 females.

Symptoms.—Until recently duodenal diverticula have been regarded as more or less harmless, and as giving rise to no symptoms. However, cases have appeared in the literature in which the diverticulum was not as innocent as it heretofore had been considered to be, and it was with this in mind that a review of 20 cases at the University Hospital was undertaken.

At the onset, one must admit that the symptoms may closely simulate gall-bladder disease, peptic ulcer, pancreatitis, etc., hence, these diseases of the right upper quadrant have to be ruled out.

In 14 of the 20 patients, the symptoms complained of could be explained on no other basis than duodenal diverticulum, because investigation by clinical, laboratory, and radiologic means in each case failed to reveal any other condition which could account for the complaint. Of the other six, two had no gastro-intestinal complaints

whatever, two had peptic ulcers, one had syphilis, one had cholecystitis. The most common symptoms present in all 14 were, bloating or fullness and pain of a more or less variable character. All of the 14 cases complained of bloating, fullness, distention, or a sense of heaviness in the upper abdomen. The pain was fairly well localized in the epigastrium in nine of the 14 cases, four had pain in the right upper quadrant, and in one, pain was absent. In nature it was variously described as sharp, dull, or crampy. It usually lasted from one to three hours and its onset was from one to two hours after meals; only four derived any relief from food or alkalies. Hemorrhage from the bowel was present in three cases, and in one there was quite a severe grade of anemia present. Hematemesis occurred in one case; nausea and vomiting were present in eight; constipation in eight, and diarrhea in two.

One interesting feature about this series was the reaction of the clinicians who came in contact, at one time or another, with this group. Ten of the 14 patients were classified as psychoneurotics, and certainly there were justifiable grounds for such a diagnosis. There was a neurotic element present in practically every one, with complaints of indigestion and "stomach trouble" dating back from two to twenty-five years; yet, any one who has really had a bellyache for fifteen or twenty years has every right to become neurotic about it.

It is possible that the symptoms may be due to any one of several things, namely, an inflammation of the pouch, an ulceration in the pouch or opposite the sac, stretching of the walls of the pouch by distention with food, or pressure of the sac on surrounding structures.

For example, in one of the cases operated on, the diverticulum was found to be in direct relation to the common bile duct and consequently marked dilatation of the duct had occurred. Since from 60 to 70 per cent

of the pouches occur in the second portion of the duodenum in the vicinity of the ampulla of Vater, it is not unlikely that interference with the flow of bile may occur more frequently than has been thought.

TYPICAL CASE REPORTS

Case 1. The patient was a white male, aged 58 years. About eight years before the present examination he began to have a dull pain in the epigastrium, coming on about two to three hours after meals and lasting for from one to two hours. At first this would occur two or three times a week, but eventually it became a daily occurrence, and was worse in the afternoon and evening. Neither food nor alkalies gave relief. About two years before the present examination he began to notice black and tarry stools on frequent occasions. At the time of admission to the hospital, he had a red blood count of about 3,000,000, and stool examinations were positive for blood. X-ray examination revealed a diverticulum 7 cm. in diameter, arising from the third part of the duodenum. No other condition or lesion could be found to account for the above symptoms.

Case 2. The patient was a white female, aged 44 years, who complained of a dull, aching pain which did not radiate, but was confined to the epigastrium. It came on about three hours after meals and lasted about one hour. Neither food nor alkalies gave relief, and bloating and distention were almost constantly present. The trouble dated back twelve years, during which time the gall bladder had been removed without relief of symptoms. X-ray examination revealed a diverticulum of the second portion of the duodenum, measuring 3 cm. in diameter, the only finding which could account for the symptoms.

The treatment is medical and surgical.

CONCLUSIONS

1. A report of a series of 20 cases of duodenal diverticulum in which this anomaly was considered responsible for symptoms in 70 per cent of the cases. Two typical cases are reported in detail.

2. The most common symptoms, in the order of frequency, are: distention, sense of heaviness in epigastrium, dull pain in epigastrium or right upper quadrant, rarely relieved by food or alkali, and vomiting.

3. Medical treatment gives good symptomatic relief in the majority of cases.

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AN IMPROVED CASSETTE HOLDER

By HARRY H. HEYLMUN, M.D., and
C. MAYFIELD, M.D., of LONG BEACH,
CALIFORNIA

This is the description of a device to be used in making gastro-intestinal examinations.

For a number of years we have been using a cassette holder that permits of making four views of the duodenal cap and gastric antrum on an 11 × 14 film. This holder is placed on the fluoroscopic table after the general survey of the chest and stomach. It is attached to counterweights, which permit of using it in the standing as well as the horizontal position or any intermediate position desired.

It occurred to us to try to improve this cassette holder so that we could get a localized pressure effect on any part of the gastro-intestinal tract along the lines worked out by Chaoul and also by Akerlund. Over the central square of this holder, which is covered with aluminum, we spread an ordinary rubber compression bladder and over this a thin sheet of veneer board, which had been countersunk to receive the deflated bladder and also the stem. An opening 5.5 × 7 inches (Fig. 1) was cut in the center of the veneer board to permit of the inflation of that part of the bladder which was underneath (Fig. 2).

The bladder is left in position at all times. When counter-pressure is desired it can be

had in any degree in any position and at any desired point by centering the bladder under the fluoroscope and operating the two-way

brief note concerning the scheme may be of general interest.

Among the causes of non-uniformity in

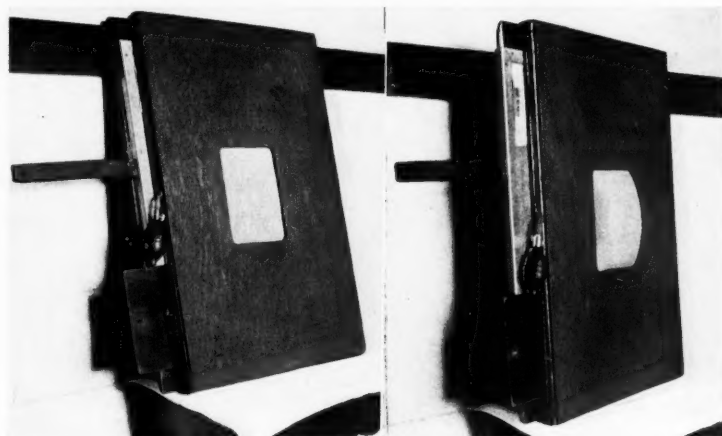


Fig. 1 (left). A 5.5×7 opening in the center of the veneer board showing bladder deflated.

Fig. 2 (right). Showing the bladder inflated by means of the bulb on the left.

bulb that is attached to the stem of the bladder.

We have found the device useful in selected cases.

THE QUESTION OF UNIFORMITY IN GOLD IMPLANTS

THE NATURE OF THE PROBLEM AND A PROPOSED SOLUTION

By E. L. HARRINGTON, Ph.D., Professor of Physics, Consulting Physicist, and E. O. BRAATEN, M.Sc., Technician, Saskatchewan Cancer Commission, University of Saskatchewan, SASKATOON, SASK., CANADA

The problem of securing uniformity in the millicurie content of gold implants has continued to be an important one in the emanation plants producing the implants and also in the hospitals in which they are used. The method developed at the radon plant of the Saskatchewan Cancer Commission at the University of Saskatchewan has proven to be such a satisfactory as well as simple solution of this problem that a

the implants produced at any one pumping the following are the more important:

(1) The crowding of gas to one end as the gold tubing is being pinched and cut off at the other end; (2) variations in length; (3) leakage, and (4) the tendency of radioactive atoms to form aggregates, resulting in a non-uniform distribution of active material along the uncut tubing. Concerning the last named cause little need be written in the present report since the nature of the phenomenon has been discussed by many writers.¹ If the radon plant delivers dry gas, little attention need be given this matter beyond cutting the tubing into the implants as soon as possible after removing the tubing from the plant.

Experience has shown that the first three causes of variation given may be substantially eliminated by employing the apparatus shown in Figure 1. The essential elements of this apparatus are two steel blades,

¹See, for example, Harrington and Gratias, *Phil. Mag.*, February, 1931, p. 285.

Q and *R*, with accurately machined edges and slightly raised teeth at intervals of 4.5 mm., by means of which the gold tubing may be divided into compartments.

used. To lessen this effect technicians often resort to halving the tubing, then halving the parts, and so on, a procedure which is tedious and involves considerable exposure

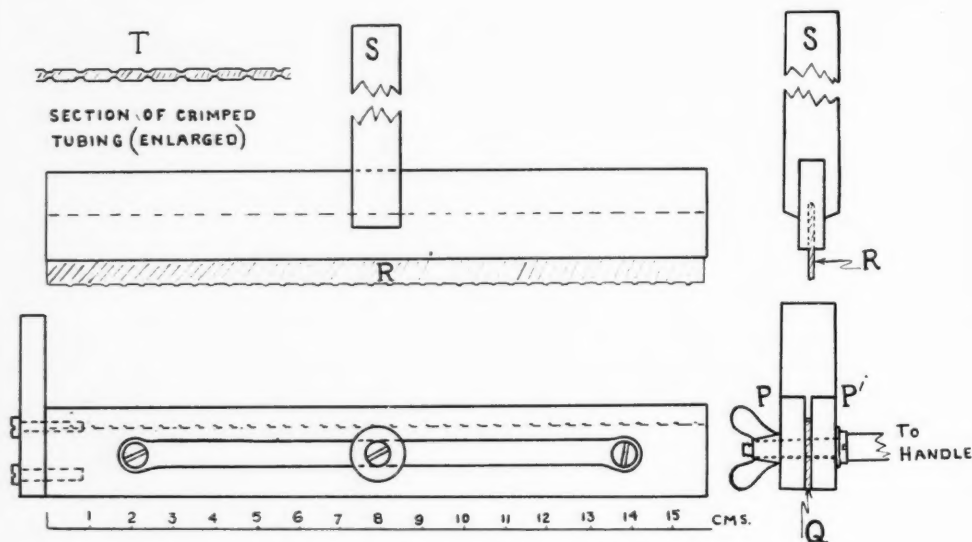


Fig. 1. See text for description.

The gold tubing as removed from the plant is placed in the narrow space between the two brass side plates, *P*, *P'*, and the free one, *P*, of the two plates tightened against the bottom toothed plate *Q*. This insures that the gold tubing, when later pressed down onto the teeth, will not be able to dodge them nor to unduly widen when flattened. The substantially mounted upper blade, *R*, is then pushed into the space above the tubing and pressed down until only the gold tubing separates the two toothed blades. A guide insures that the teeth of *R* will be directly above those of *Q*, throughout. A suitable blow by a hammer on *S* then accomplishes two objects at one stroke: First, it crimps the gold tubing at the positions of all pairs of teeth simultaneously. This eliminates the gradual crowding of the gas from one end to the other, which takes place when pliers are

without fully accomplishing the object in mind, and which results in a variety of lengths or a wastage. In the second place, the method guarantees uniformity in length, since the teeth are evenly spaced. Finally, it lessens the chance of leakage for two reasons: The whole tubing space is divided in an instant into gas-tight compartments, so that an imperfect seal at one end of the tubing cannot continue to leak, as the tubing is being cut into implants as in the usual direct pliers plan. In the second place, the teeth, each having a flat face about a millimeter in length, press shut the bore for corresponding spaces, thereby adding insurance against leakage when the tube is finally cut into implants.

The next step is to loosen *B* and remove the crimped gold tubing—which then has the appearance shown by *T*. Finally, the tubing is cut at each crimped point by dull

pliers in the usual manner. This may be done rapidly as the indentations or notches in the tubing serve as stops by catching the blades of the pliers.

The two blades are of hardened steel; the remaining parts of the apparatus are of brass. Compared to the steel, the gold is so soft that the apparatus should last indefinitely.

Results.—It has been and is still our practice to measure implants individually even though the uniformity now attained may make this precaution unnecessary. A few typical cases will illustrate the degree of

uniformity obtained by the method above described: Of 29 implants, 18 had a millicurie content of 3.03; 10, a content of 3.08, and 1, a content of 2.96. Out of a total of 22 implants, 7 had a content of 3.46, 14 a content of 3.33, and 1 a content of 2.80.

While these cases are typical, almost perfect uniformity is occasionally obtained, and at other times uniformity not quite so high: the end ones are likely to be short. When one compares this uniformity with the wide variations, often up to threefold, obtained by the simple pliers method generally employed, the advantages of the new method are as striking as they are apparent.

EDITORIAL

LEON J. MENVILLE, M.D. . . . Editor

BUNDY ALLEN, M.D. . . . Associate Editor

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A RADIOLOGICAL CONCEPT OF THE TREATMENT OF CANCER¹ OF THE BREAST¹

No uniform method of procedure has been standardized and adopted for handling patients with suspected cancer of the breast—the debatable points resting mainly in the diagnosis—but when the diagnosis has been satisfactorily completed, it is not difficult to lay out the proper treatment.

Since my purpose is to speak briefly concerning the radiological agents available for the treatment of carcinoma of the breast, I will avoid the controversial points pertaining to methods of obtaining tissue for biopsy—whether by aspiration through a large caliber needle, or by direct incision into the tumor area. The relative or comparative safety of either of these methods is still undetermined, particularly so if the sections must be obtained at some distance below normal skin and fascia. Experience has proved either method safe when immediately followed by radical surgery, but when such surgery is delayed for any reason, the result may spell disaster to the patient.

In all patients with a suspected area or mass lying deep within the breast, and not attached to the skin, we advise surface irradiation either with x-ray or radium prior

to the obtaining of the specimen, as we are convinced that this is proper both theoretically and practically. With frankly operable patients, in whom every clinical phase of the case points to cancer, the grade of malignancy is, of course, established by the pathologist after removal of the mass.

What is the relationship existing between surgery and radiation? Is there a closer bond being established between the advocates of the scalpel and the users of radiation therapy? Results obtained during the past few years have partially bridged the gap, and it now appears that the span will be complete in the not-far-distant future.

As many of our surgical colleagues are still holding to the belief that the treatment of breast malignancies by x-ray or radium is ineffective, the radiologist must gather his facts together and present them to his surgical friends in a manner which will supply all clinical data as accurately and completely as a report emanating from any other recognized and authoritative statistical body.

This again brings up the perennial question of compiling cancer statistics—a highly laudable but well nigh insurmountable accomplishment, a work which must not be lost sight of, however, so that we may eventually have something equally comparable with the present acceptable surgical statistics.

Now that radiology has broadened its scope and enlarged its field of activity, the question of procedure becomes just as pertinent from the radiological as from the surgical point of view. The radiologist does not always agree with his equally competent brother as to the management of a specific breast cancer patient, so, in order to be specific, I name radiation therapy as the first line of offense in breast cancer, and vouch-

¹Presented before the Fourth Pan-American Medical Congress, Dallas, Texas, March 24, 1933.

safe the statement that this agent should be used in all patients with cancer of the breast—primary, metastatic, or recurrent—and that surgery should be limited to those primary tumors of the breast which prove to be radioresistant after an adequate course of x-ray therapy or radium implantation, or both. We are, of course, all agreed that, when mechanically possible, a sloughing, painful, and malodorous mass should be surgically removed, if for no other reason than that of palliation or temporary sanitation.

The progress of radiology shows that its scope is greater than anyone would dare define, and new evidence is daily accumulating from the world's great medical centers that the intrinsic value of radiation energy must be recognized as of paramount importance in the treatment of breast cancer.

From the time when radiation therapy first appeared I have maintained that surgery came first in breast cancer, which statement is verified in the various papers I have offered upon this subject during the past twenty years. In view of the progress which has been made during that period, however, I am now convinced that my former stand is no longer tenable. We must now turn to the one and only agent which has demonstrated, beyond all peradventure, its ability to destroy cancer cells—the energy of radiation. This change of front on my part is not due to any spectacular results achieved by radiation, but, rather, to the realization that surgery, *per se*, has decisively failed to change the clinical cure period over that which maintained before modern radiation therapy came to the front—and this, in spite of the best efforts of the world's most outstanding and accomplished surgeons. In other words, surgery has made no appreciable progress in handling this problem, while radiation most certainly has.

Another question which has not as yet been satisfactorily answered is, What are the limits of radiation? Personally, I have

already voiced my opinion and stand ready to defend my position. If cancer of the breast is curable by surgery, it is equally curable by radiation, and the end-result depends almost wholly upon the ability of the surgical or radiological clinician. Obviously, there are a great many operations performed by general practitioners which may detract somewhat from the efficiency shown in surgical statistics. To offset this, however, many of us radiologists are equally unprepared to do the very highest type of work on breast cancer, but there is now enough knowledge available to correct this condition.

Radium and x-rays are physical agents employed in the treatment of cancer to accomplish the slow cellular transmutation or, if you please, the absorption and elimination of the offending mass. These agents cannot, of course, be used for the direct destruction or mechanical removal of a tumor, in cases in which an extensive ulcerating or necrotic condition involving the skin and surface requires the cold scalpel, actual cautery, or, better still, the radio-knife or electrotome.

The first requisite in all classes of carcinoma of the breast is to thoroughly irradiate the entire area, including all contiguous lymph channels, with short wave length x-rays. This is accomplished by the so-called tangential method of Holfelder, sparing the lung fields as much as possible from radiation effects. This treatment takes from two to three weeks, depending upon the daily dosage and the amount of involvement, and necessitates a subsequent rest of three to four weeks to permit the tissues to regain equilibrium; in other words, until the subsidence of the usual tissue reaction has taken place.

The individual peculiarities of each patient must, of course, be considered, but, generally, cases are well covered by this procedure. If we are handling a patient with much skin involvement and surface

necrosis, there is usually found, at the end of this x-ray reactionary period, a marked reduction in the tumor, less fixation, and definite recession of the lymph nodes in cases presenting palpable metastatic involvement. Such patients are then hospitalized for the removal of the offending mass by the electrotome, while, at the same time, platinum radium needles are methodically plunged into all gland-bearing tissues according to the methods described by Keynes. Skin permitting, the operative wound is closed, but if the tumor removed is too large to permit of this, the wound is allowed to heal by granulation or, in some cases, skin grafts are employed to assist the healing process.

Where the skin is not directly invaded (without regard to the size of the underlying tumor) surgery is not undertaken, but the radium needles are inserted around the tumor mass to accomplish its complete sterilization, after which all gland fields are subjected to implantation, as already described. As many as from 35 to 50 such needles are methodically placed within the parts described, where they remain *in situ* for from seven to twelve days.

Our attention was drawn to this type of treatment by Lord Berkeley Moynihan in 1929, who reported this pioneer work of his British radiological colleagues before a group of physicians in the New York Memorial Hospital. My associates and I immediately procured radium needles of the type described by our distinguished visitor, and started to employ them in our practice. We realized at once the importance of filtered radium needles for interstitial use, as we had in previous years used steel needles, which have a low filtration value. The steel needles had worked splendidly in tumor destruction but invariably left necrotic areas around the points of insertion, thus making their continued application undesirable.

Now, after three years continued experi-

ence in the practical use of platinum radium needles, we have found that our immediate results are far better than we have secured by any other form of treatment, though we cannot as yet offer any five-year statistics. Suffice it to say that our 45 patients who have been treated by this process have so far shown a minimum of metastatic development; three have died, and six have shown local recurrences, principally in the line of the pectoral muscle, where deep-seated glands escaped the primary radium barrage. In three of these six cases subsequent radium implantation has been helpful, while in two recent patients the time is yet too short to warrant us in recording the effect. In none of the cases under discussion has the usual chain gland involvement shown further activity, although this may occur later. It must be borne in mind that all the patients here enumerated were in the so-called inoperable class, a few being local recurrences following former surgery.

Based upon the foregoing experience, we now feel warranted in recommending this type of therapy in every case in which there is a reasonable certainty of primary carcinoma, irrespective of whether or not extension or metastatic nodes are demonstrable. We anticipate a serious protest over this announcement, with statements to the effect that some of the patients we treat have not malignant disease, that we do not obtain microscopic confirmation, that we claim clinical cures for malignancy when we are dealing with chronic mastitis and fibroadenomas of various types. This, of course, is always possible where the clinical diagnosis is in doubt, but the preliminary course of x-ray radiation usually settles the argument and determines whether or not it is necessary to carry on to complete cancer sterilization by the before-mentioned radium implantation.

ALBERT SOILAND, M.D.

PUBLICITY COMMITTEE REPORT

September 30, 1933

Your Publicity Committee herewith begs to submit a brief report of its activities for the period preceding and during the Congress, closing to-day. While it is too early to tell the full results of our efforts, we felt that you would want to become familiar with the broad scope of what has been done.

The press of both the Americas and the radio have been our chief means of communication with the lay public in publicizing the Congress. We have used the medical journals extensively to get our message to the physicians. We believe that the great amount of publicity obtained prior to the Congress certainly helped bring a number of members into the Congress. This was perhaps particularly true in South and in Central America and in Canada, whence we would have had a considerable number of delegates under more favorable economic conditions.

Classified, we may report the following: Use of the daily press—by wire services (AP-UP-Universal-INS) and by personal contact and mail.

The first stories on the Congress were released two years ago and again a year ago, and we have been active since March, 1933, in keeping up the publicity, especially concentrating on the work since August 1, 1933.

Before the meeting, we obtained many columns of space relative to the Congress. This included use of state wire services with "localized" stories telling of essayists from that state, etc. The AP and UP put out several stories that we prepared, and we have clippings showing that hundreds of papers used these stories. In addition, we received very favorable stories, usually page one, in large papers in Havana, Buenos Aires, and elsewhere.

The local press in Chicago carried a number of advance stories. In the magazine field, the "Chicago Visitor," a journal with

over 50,000 monthly circulation, used a long, illustrated feature article, concerning the Congress and the development of commercial companies.

"Time" will carry considerable material in its next two issues. This famous magazine has a weekly circulation of almost a million.

Your Committee set up a comprehensive radio program through the courtesy of National Broadcasting Company and several large local stations. We thus were able to put 14 speakers on the air, six heard over national hookups. We believe that this was the first radiological meeting ever to obtain time over national hookups. Stations WGN, KYW, WCFL, and WLS likewise gave generously of their time for our speakers. A Columbia hookup was also arranged, but the speaker was unable to be present, and the arrangement was cancelled.

Despite a heavy news week, we were able to obtain fine local publicity. Three leading papers—the *Tribune*, *Herald and Examiner*, and *American*—carried at least half a column each day for seven days, with a number of pictures. The other two papers did almost as well. The *Tribune* assigned its chief science writer, Philip Kinsley, and its chief "medical" reporter, Miss Kathleen McLaughlin, to the meeting. The City News Bureau was particularly helpful in covering the entire local field. In addition, the Associated Press and United Press covered the Congress with a number of stories, being sent to all parts of the Americas. The science editor of Universal Service, Mr. Gobind Behari Lal, was given papers in advance, wrote features for all Hearst papers, and Science Service from Washington sent out several stories. Full results will be submitted in proof when the clippings are all received.

The Committee has had the services of Miss Ethel Hanzlik and Messrs. Aubrey Cribb and Dick Smith, of the firm of Dick Smith & Associates, worked closely and

helpfully with the Publicity Committee at all times.

The Committee especially appreciates the help given it by the local Executive Committee, the presidents and officers of the various societies, and the radio speakers who co-operated wholeheartedly in our work and who were "good sports" throughout regarding this difficult phase of the Congress.

JAMES T. CASE, M.D.

B. C. CUSHWAY, M.D.

Publicity Committee

COMMUNICATIONS

OPEN LETTER TO GRADUATE AND POST-GRADUATE MEDICAL SCHOOLS

An association of radiologists known as the Pacific Roentgen Club was recently formed in California. It was organized partly to further the interest of good medical care and partly to protect the position of radiology as a recognized branch of medical practice.

It has happened in the past that certain laboratory groups, under the guise of Medical Clinics and of Hospital Associations, have induced radiologists from other States to come to California, and that after arrival these men have found the positions very different from what they anticipated.

It is, therefore, suggested that before men go to the expense and trouble of coming to the Pacific Coast to take up practice, especially in connection with hospital positions, they write to one of the members of the Club and secure information concerning the status of their prospective appointments. It is believed that if such action is taken in advance the results will be more than mutually beneficial.

L. HENRY GARLAND, M.D.

Secretary, Pacific Roentgen Club

FOURTH INTERNATIONAL CON- GRESS OF RADIOLOGY

JULY 24-31, 1934

The Fourth International Congress of Radiology will be held in Zurich, Switzerland, under the patronage of the President of the Confederation. The last days of the Congress and the closing session will take place in St. Moritz (Engadine).

Ordinary members of the Congress must be:

(a) members of radiological societies of any country, or (b) persons recommended by such societies.

Relations of the ordinary members who want to take part in the entertainments may attend the Congress as associate members.

The membership fee is: for ordinary members, 60 Swiss francs; for associate members, 30 Swiss francs.

Persons who wish to be registered as members should send the following information to the General Secretary, Gloriastrasse 14, Zurich, and the membership fee to the "Schweizerische Kreditanstalt" in Zurich before Jan. 1, 1934. (Account "Radiologenkongress.")

Full name:

Profession and academic titles:.....

Member of the Radiological Society of.....

Address:

Names of associate members:.....

A list of members will be issued in form of a portrait-catalogue.

At the opening session representatives of the various countries will report on the organization of the cancer campaign in their country. These reports will be published in a special volume.

At the general meetings the following subjects will be treated:

X-ray Diagnosis of Bone Tumors
Vasography

The Development of Pulmonary Tuberculosis as Seen Radiologically
Radiation Treatment of Uterine Carcinoma

Radiation Treatment of Malignant Tumors of the Mouth and Pharynx
Radiation Genetics

Mitogenetic Radiation (Mitogenetische Strahlung)

Structure Analysis

Identical Physical Measurement of the Dose in X-ray and Radium Treatment

Hard Gamma Rays, Cosmic Radiation, Earth Radiation

Short Wave Therapy (Kurzwellentherapie)

The speakers have been chosen after consultation between the Committee and the radiological societies of the respective countries. Every member is entitled to take part in the discussion. Further, special invitations to participate will be issued by the Committee to certain members. In addition, discussions will be held in the six sections and every member is entitled to present a communication of fifteen minutes' length. The choice of subject is free, but the Committee suggests the following as being of special interest and will welcome such contributions:

Radiological Diagnosis: Radiological Kymography; Factors in the Production of the Mucosa Autoplastic; Radiological Investigation of Skeletal Movement; Radiological Investigation of the Mamma; Sources of Error in Cholecystography; Gastric Diagnosis Using Air Distention.

Radiotherapy: Possibilities of High Speed Cathode Rays; Treatment with Highest Tension X-rays; Comparison between Teleradium and Deep X-rays; Principles in the Construction of Cancer Statistics, Showing the Result of Treatment; Principles and Practice in the Treatment of Metastases (Surgery, X-rays, Radium, Lo-

cal and Distant Radium); The Applications of Radiotherapy to the Sympathetic System.

Radiobiology: The Quantum Problem with Respect to Radiobiology; The Relation between Quality and Biological Effect of Short Wave Radiations; Radiohistology.

Radiophysics and Technic: Protection during Screening; Measurement of Tension and Current of an X-ray Tube (Questions of Exposure); Film *versus* Paper; Chemical Effects of Short Wave Diathermy; Absorption Effect and the Production of Secondary Radiation (Transitional Effects).

Electrology: End-results of Electrocoagulation; The Production of Alternating Electric Fields of High Frequency and Their Biological Effect.

Heliotherapy: Acclimatization to Visible Rays; Infra-red Radiation; Long Ultra-violet Waves.

Members who wish to present a paper should notify the General Secretary before Jan. 1, 1934, and supply him with a typewritten summary (not exceeding 400 words) in German, French, or English before April 1, 1934. These summaries will appear in the special volume which will be issued to all the ordinary members before the beginning of the Congress.

In connection with the Congress an exhibition of apparatus, photographic accessories, chemical products, and scientific books will be organized. (Applications to A. Strelin, Rämistrasse 7, Zurich, Switzerland.)

Further particulars and the definite program will be sent to registered members only.

For the Organizing Committee

PROF. DR. HANS R. SCHINZ,

President.

DR. MED. HANS E. WALTHER,

General Secretary.

ANNOUNCEMENTS

ACCREDITED COURSES FOR X-RAY TECHNICIANS

At the joint meeting of the Registry Board and the Council on Education and Registration of the American Society of Radiographers the following minimum requirements for training courses for x-ray technicians were agreed upon:

1. The minimum entrance requirements are a complete high school education; minimum age 19 years. It is preferable to take applicants with a college education or a graduate nurse's certificate.

2. A qualified radiologist must be in charge of the laboratory where the course is given.

3. The course must extend over one year full time service.

4. The work is to consist of lectures, practical work in the laboratory, and home study.

5. A comprehensive written and oral examination is to be given at the end of the course covering theory and practice of radiological technic. A certificate should be issued to the successful applicant.

Radiologists who wish to have their courses placed on this accredited list please communicate with the Secretary of the Registry Board, Dr. E. A. Pohle, Department

of Radiology and Physical Therapy, University of Wisconsin, Madison, Wisconsin.

UNIVERSITY OF WISCONSIN ROENTGEN CLUB

The U. of W. Roentgen Club held its first meeting on Thursday, October 26, 1933. The following topics were discussed: "Lesions of the Cardio-esophageal Region" (Dr. L. W. Paul); "Extra-gastro-intestinal Masses" (Dr. L. W. Paul), and "Radiation Therapy in Mediastinal Tumors" (Dr. E. A. Pohle).

Dr. C. R. Bardeen, Dean of the Medical School and Honorary Member of the Radiological Society of North America, is Chairman this year, and Dr. E. A. Pohle is Secretary. Meetings will be held on the last Thursday of each month from October to April.

CLEVELAND RADIOLOGICAL SOCIETY

The President of the Cleveland Radiological Society is David Steel, M.D., of Lakeside Hospital, and Otto Glasser, Ph.D., of the Cleveland Clinic Foundation, is the Secretary and Treasurer.

The meetings are held on the fourth Monday of each month at the Cleveland Chamber of Commerce, at 6:30 P.M., from October to April, inclusive.

ABSTRACTS OF CURRENT LITERATURE

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E. T. Leddy, M.D.

D. H. Pardoll, M.D.
E. A. Pohle, M.D., Ph.D.
C. G. Sutherland, M.D.

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BLOOD CHANGES

The Immunity Fall in the Bactericidal Power of the Blood for Eberth's Bacillus in Rabbits Treated with Roentgen Rays. Lorenzi Angelo. *Archivio di Radiologia*, 1932, VIII, 435-443.

Angelo studied the immunity fall of the normal bactericidal property of the blood for Eberth's bacillus in rabbits immunized to the bacillus and treated with small repeated doses of x-rays during the vaccine treatment. He found that the fall of the bactericidal power of the blood of immunized rabbits is not as complete nor as rapid as in the control animals.

E. T. LEDDY, M.D.

BONE (DIAGNOSIS)

The Radiologic Examination of the Skeleton in Scleroderma. Carlo Guarini. *Archivio di Radiologia*, 1933, XI, 7-56.

Systematic studies of the bones of scleroderms have not been reported very frequently. The author illustrates the findings in eight cases, from which he concludes that scleroderma should be regarded as a systemic organic disease rather than as a dermatologic lesion. The changes in bone he observed were not pathognomonic of the disease.

E. T. LEDDY, M.D.

CANCER (THERAPY)

The Radiation Therapy of Uterine Cancer at the Women's Clinic, University of Heidelberg. F. G. Dietel. *Strahlentherapie*, 1933, XLVI, 201-272.

The author presents a detailed analysis of the uterine cancer patients seen in the Women's Clinic, University of Heidelberg. The method of treatment during the period 1913-24, with statistics of all treated cases, critique of the method, and present methods are described. He concludes that he will continue the radiation therapy of cancer of the cervix but operate on all patients with radiorefractory tumors.

ERNST A. POHLE, M.D., Ph.D.

CYSTS

A Contribution to the Radiologic Diagnosis of Atypical Findings in Hydatid Cyst of the Lungs. Teofilo B. Melazzi. *Arch. di Radiologia*, March-April, 1933, XI, 257-287.

A roentgenologic diagnosis of hydatid disease of the lung is not usually easy to make. The author presents in detail the radiologic appearance in eight

cases, discussing some of the lesions that had to be considered in differential diagnosis.

E. T. LEDDY, M.D.

DOSAGE

Comparative Studies Concerning the Effect of Roentgen and Radium Rays. H. Holthusen. *Strahlentherapie*, 1933, XLVI, 273-288.

A comparison of the epilatory effects of equal doses of x-rays and radium showed a slight preponderance of the radium reaction. The injury curves of *Ascaris* eggs for both radium and x-rays were nearly identical, provided the same number of r per minute was applied. The importance of the time factor in the treatment of malignant tumors is emphasized.

ERNST A. POHLE, M.D., Ph.D.

Effect of Roentgen Rays of Different Wave Length on Biologic Objects. R. Glocker, H. Langendorff, and A. Reuss. *Strahlentherapie*, 1933, XLVI, 517-528.

The authors continued their experiments studying the effects of radiation on biologic objects. In this paper they used *Saccharomyces ellipsoideus* and homogeneous roentgen rays of the wave lengths 0.56 and 1.54Å. No difference in the shape of the injury curve could be detected. When using alpha irradiation the injury curve took a more flat course than when using roentgen rays. When using the r unit in expressing the dose the half value dose for the harder rays was approximately 50 per cent higher than for the softer roentgen rays.

ERNST A. POHLE, M.D., Ph.D.

Potentials Necessary to Produce Saturation Currents in Condensers. Hermann Hegels. *Strahlentherapie*, 1933, XLVI, 757-774.

For ionization measurements, particularly in x-ray work, it is essential to have saturation current. The author conducted a series of experiments determining the potential necessary for saturation current if condensers of the plate, cylinder or sphere type are used. The results are presented in numerous graphs and tables.

ERNST A. POHLE, M.D., Ph.D.

EXPERIMENTAL STUDIES

The Effect of Radium on the Offspring of Plant Lice. Robert Kirschner. *Strahlentherapie*, 1933, XLVI, 663.

The author studied the influence of radium rays on *Macrosiphum tulipae* Hb. There was a marked influ-

ence on the fertility which was reduced in the first, most in the second, and still in the third generation. Small doses of radium had a stimulative effect on the growth. This manifested itself particularly in the first generation. There was also a marked effect on the maturing period. While the normal time for the larvæ was from 9 to 11 days this was reduced in the offspring of irradiated females to from 6 to 9 days. The author emphasizes the statement that the effect of radiation did not manifest itself only in the first generation alone, but also in later generations.

ERNST A. POHLE, M.D., Ph.D.

Experimental Studies as to the Question of the Biologic Effect of Roentgen Rays. A. Löw-Beer. *Strahlentherapie*, 1933, XLVI, 469-516.

This is a report of extensive studies of cholesterol changes in solutions *in vitro*, in male mice and in human patients after irradiation. It appeared that the effect of roentgen rays on cholesterol solutions varies according to the medium in which cholesterol had been dissolved. If male mice are exposed to 2,000 r, the total cholesterol content of the animals is definitely increased four days following the exposure. Doses as low as 300 r still produce this increase but not in so marked a degree. Extirpation of the spleen did not alter these results. Extirpation of the liver, however, produced a drop in the total cholesterol content after exposure to 600 r. These variations in the cholesterol content of the animals or in single organs and in the blood following irradiation are said to be due to a cholesterol deposit in the organs or in the reticulo-endothelial cells. The variations of the cholesterol content in the human blood were not uniform. In some cases there was abrupt change, in some cases no change at all even though x-ray sickness was present.

It seems evident that the cholesterol content of the blood is not the only factor determining systemic reactions following irradiation. A very complete bibliography is appended.

ERNST A. POHLE, M.D., Ph.D.

The Effect of Roentgen Rays on the Mineral Metabolism of Multiple Implanted Sarcoma of the White Rat. Lieselotte Kluge and Hans-Georg Zwerg. *Strahlentherapie*, 1933, XLVI, 293-310.

Roentgen irradiation of sarcoma in female rats weighing from 150 to 200 grams leads to an increase in the calcium content of the tumor as high as 400 per cent. The animals themselves show a loss of potassium and magnesium but an increase in water content. Young female animals showed an entirely different behavior. The observed shifting of the minerals in the tumor is not due to a local effect, since irradiation of other parts of the body brings about the same results. The authors feel that the

observed phenomena probably can be explained by mobilization of hormones, particularly that of the posterior lobe of the hypophysis.

ERNST A. POHLE, M.D., Ph.D.

The Behavior of the Reticulo-endothelial System in Irradiated Tumor Animals. A. Calò. *Strahlentherapie*, 1933, XLVI, 529-544.

White mice were exposed to small doses of roentgen rays. They showed a definite increase in resistance toward the growth of transplanted tumors. In the author's experiments the resistance was at its peak if the interval between irradiation and transplantation was one month. Histologic studies showed that such animals showed signs of an increased function of the reticulo-endothelial system. The same treatment was without effect if carried out from 10 to 23 days after the tumors had been transplanted. High local doses given over the tumors from 13 to 20 days after the transplantation had no effect.

ERNST A. POHLE, M.D., Ph.D.

Experimental Studies as to the Influence of Nutrition on the Radiosensitivity of Animal Tissue. Erich Uhlmann. *Strahlentherapie*, 1933, XLVI, 550-563.

The author determined experimentally the doses necessary to produce epilation by roentgen rays in rabbits. Using 50 K.V., it required 500 r; using 140 K.V., about 700 r were necessary. Very interesting was the effect of the diet on the epilation dose. In the extreme case the susceptibility of the rabbit could be increased 100 per cent. Rabbits kept on barley only showed complete epilation following half of the dose that was required in rabbits on a regular mixed diet. The author believes that this phenomenon can be explained by the fact that certain diets produce acidosis.

ERNST A. POHLE, M.D., Ph.D.

The Effect of Roentgen Rays of Different Wave Lengths on Biologic Objects. H. and M. Langendorff and A. Reuss. *Strahlentherapie*, 1933, XLVI, 289-292, 655-662.

Experiments showed that the shape of the injury curve for eggs of *Axoloti* is the same for radiations produced at 180 K.V. filtered through 0.8 mm. Cu and 80 K.V. filtered through 1.5 mm. Al. If homogeneous rays of 0.56 and 0.18 Å. were employed, there was also no influence of the wave length on the slope and shape of the injury curve detectable.

The authors continued their studies, this time choosing *Mesotacnium caldiorum* as the biologic test object. If cultures of these plants were exposed to roentgen rays of 0.56 Å. and 1.54 Å., the injury

curves had the same slope. The so-called half value doses varied, however, 1.8:1. No difference could be detected between the injury curves for roentgen rays and for ultra-violet rays. The effect of the time factor was extremely small.

ERNST A. POHLE, M.D., Ph.D.

FRACTURES (THERAPY)

The Effects of Hard and Soft Radiations on the Formation of Osseous Callus. M. Lambranzi. *Arch. di Radiologia*, March-April, 1933, XI, 247-250.

The author fractured the femur of rabbits and then irradiated them with rays generated at from 110 to 190 kilovolts, with filtration of from 1 mm. aluminum to 0.5 mm. copper plus 3 mm. aluminum in moderate doses. Histologic study twenty-five days later seemed to show that hard rays favored more than soft rays the evolution of the callus into the osteoid stage.

E. T. LEDDY, M.D.

GALL BLADDER (NORMAL AND PATHOLOGIC)

Cholecystography: Its Clinical Evaluation: A Study of 2,070 Cases. Arthur N. Ferguson and Walter L. Palmer. *Jour. Am. Med. Assn.*, March 18, 1933, C, 809-812.

This is a review of the authors' experience with intravenous cholecystography over a period of five years. Their conclusions are: A good visualization of the gall bladder by cholecystography, with no evidence of stones, indicates a normal gall bladder in a high percentage of cases. The accuracy of diagnosis when stones are demonstrated as positive or negative shadows approaches 100 per cent. The accuracy of a faint visualization, when combined with a clinical history suggestive of biliary disease, is 58.3 per cent; that of non-visualization when combined with a positive clinical history, 90 per cent. In the absence of a clinical history suggestive of gall-bladder disease, the accuracy of a faint visualization is less than 14 per cent; that of non-visualization, considerably less than 66.6 per cent. In the cases in which cholelithiasis was found at operation, a history of colic was noted almost as frequently as was cholecystographic evidence of gall-bladder disease.

C. G. SUTHERLAND, M.D.

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

A Seriographic Study of the Ileocecal Region and of Stierlin's Phenomenon. Pietro Perona. *Arch. di Radiologia*, March-April, 1933, XI, 173-204.

The author presents a detailed exposition of the

peristalsis of the terminal ileum before and during the passage of the meal into the cecum and shows that in the normal there is first filling of the cecum and then of the ascending colon and that in certain phases there can be seen an active regulation of the process by the valvular region of Busi. The inversion of the filling mechanism is usually due to irritative stimuli which start in neighboring regions. This phenomenon is important in cases in which a diagnosis of the condition of the appendix may depend on indirect signs. Serial study alone can show the various stages of its filling. The author feels that the valvular region of Busi is of great importance in Stierlin's phenomenon.

E. T. LEDDY, M.D.

GENITO-URINARY TRACT (DIAGNOSIS)

Case of Hydro-accessory-ureter in a Child of Ten Years. G. G. Bruce. *British Jour. Surg.*, April, 1933, XX, 672-675.

The author reports a case of congenital hydro-accessory-ureter in a small girl which caused obstructive symptoms, with the production of hydro-nephrosis and dilatation of the primary calices. The pathology was probably caused by the pressure exerted upon the normal ureter by the descent and medial rotation of its pathologic mate. Pyelograms and illustrations of the operative specimen accompany the article.

DAVIS H. PARDELL, M.D.

Painful Lumbo-ischiatic Syndromes and Changes in the Urinary Tract. Mario Buisson. *Archivio di radiologia*, 1932, VIII, 407-425.

Buisson, as a result of study of 150 cases with this syndrome, agrees with Busi, Mainoldi, Ottomello, Nuvoli e dell' Impiombato and others on the association of lumbosacral deformities with changes in the urinary tract. A demonstration of idiopathic renal colic brings in the probability of the painful lumbo-ischiatic syndrome being due to functional disorders in the urinary tract. This distinction is of great diagnostic and therapeutic importance because these functional changes may become organic with the passage of time, as is the case in the highest percentage of vertebral anomalies in urinary calculosis, presenting little chance of benefit from treatment.

E. T. LEDDY, M.D.

Primary Benign Neoplasm of the Ureter. G. A. B. Walters. *British Jour. Surg.*, April, 1933, XX, 682, 683.

The author reports a case of primary benign neoplasm of the ureter in a married woman, aged

58. The patient complained of renal pain, hematuria, and a palpable swelling in the right renal area. Cystoscopic examination revealed a normal bladder and left orifice; at the right orifice a small tag of growth was presenting and the author was unable to pass a ureteric catheter on that side. The attempt did not cause any marked hemorrhage. No dye was seen from the right side in fifteen minutes. Uroselectan B showed that the pelvis and calices of the left kidney were normal; there was no excretion visible from the right kidney.

Under spinal anesthesia, a large hydronephrotic kidney was delivered with considerable difficulty, and the ureter was seen to be tortuous and dilated. It was divided low down with the cautery and the kidney was removed. Next the bladder was exposed through a sub-umbilical incision; the right side was dissected clear, and the remainder of the ureter, together with a small wedge of bladder, including the ureteric orifice, were removed. Examination of the tumor showed a simple papilloma covered with epithelium of transitional character. There was no evidence of malignancy. Illustrations of the pathologic specimen accompany the article.

DAVIS H. PARDOLL, M.D.

Carcinoma of the Male Urethra. R. H. Boggon. *British Jour. Surg.*, April, 1933, XX, 640-644.

The case reported was situated in the fossa navicularis in a 60-year-old patient. The outstanding point of interest in the microscopy of the growth is the preponderance of the squamous-celled variety. Robb, in an analysis of 76 cases, found 72.5 per cent were squamous-celled, 21.2 per cent adenocarcinoma, 3.5 per cent papillary, 1.5 per cent columnar-celled, and 1.3 per cent transitional-celled. Bieberbach and Peters state that 60 per cent are squamous-celled, and other writers are of the same opinion. Normally the epithelium lining the perineal part of the urethra (the common site for the disease) is columnar, but Sobotta states that it is usually of a stratified columnar type and in some individuals islets of squamous epithelium can be seen. The change is probably best explained by metaplasia consequent to the malignant transformation, although the possibility of embryonal cell-nests has been suggested. In this case, although the growth occurred in a region where stratified squamous epithelium is usual, it assumed the form of a transitional-celled growth, a type which might reasonably be expected in the prostatic urethra.

A consideration of the results as published in the literature indicates a gloomy prognosis. The majority of patients succumb to the disease in from six months to two years. Recurrence takes place locally, with or without spread in the inguinal and iliac glands.

Carcinoma of the urethra is probably not such a rare condition as the literature suggests, for it is

more than probable that many cases are not recorded. Association of the condition with stricture and peri-urethral abscess should be borne in mind, as it is obviously essential to make an early diagnosis. The high proportion of squamous-celled growths in the urethra and the recent improvement in the treatment by modern radium therapy of this type of neoplastic cell in the genito-urinary system, make such a method of treatment well worth a trial in an otherwise almost hopeless condition.

DAVIS H. PARDOLL, M.D.

Congenital Vesical Neck Obstruction in a Female Child, Due to Cup-valve Formation: Open Operation: Complete Recovery. A. Harris. *Am. Jour. Surg.*, April, 1933, XX, 64-69.

In conditions of dilated bladder in infants and children, with or without diverticula, nerve and cord lesions, urethral stricture, and meatal obstruction having been ruled out, the urgent need for careful instrumental study of the vesical neck region and posterior urethra is apparent. The author believes that the true etiology will thereby be more frequently demonstrated, and the irritant factors removed before advanced disease changes have taken place; furthermore, idiopathic dilatation of the bladder will less often be the accepted diagnosis.

In congenital obstructive cases, the degree of obstruction is naturally the determining factor in the severity of symptoms, and in bringing the patient to a correct diagnosis at an earlier period of life.

With the popularization of cysto-urethroscopic study in children, more vesical neck lesions are being demonstrated. A number of valve formations in male children associated with the embryologic defects of the verumontanum and hypertrophied frenula are recorded. The latter condition does not apply in the case recorded in this article.

As far as the author is aware, this is the first case of congenital valve obstruction at the vesical neck in a female child to be reported in the literature. Campbell reports a recent case of trigonal curtain behind the vesical outlet in a female child of fifteen months. This case is in a measure somewhat similar, but not the same lesion. The effects produced by the lesion, however, are almost identical.

DAVIS H. PARDOLL, M.D.

GENITO-URINARY TRACT (THERAPY)

Bladder Tumor: Observations on 150 Cases. G. G. Smith and E. R. Mintz. *Am. Jour. Surg.*, April, 1933, XX, 54-63.

A total of 150 cases of tumor of the bladder were studied as to age, symptomatology, type of tumor, treatment, and end-result. The authors also analyzed 37 autopsies as to type and grade of cancer, presence

and distribution of metastases, and existence of other pathologic conditions. They decided that the grade of malignancy of bladder cancer has no demonstrable relation to its tendency to metastasize. Squamous-cell cancers metastasize almost twice as frequently as papillary cancers. They also concluded that one important cause of the poor results in the surgery of bladder cancer is the long period of delay between the occurrence of the first symptom and the patient's entrance into the hospital.

A comparison of the results of resection, electrocoagulation, and radium implantation shows the lowest number of hospital deaths in cases treated by electrocoagulation (26 per cent). The next lowest is in cases treated by resection (32 per cent); the highest is in cases treated by radium implantation (41 per cent). The end-results from these three methods are approximately the same. As no one method is suitable for all types of cancer, the surgeon should be prepared to employ whichever method seems best suited to the individual case.

DAVIS H. PARDOLL, M.D.

Perirenal Hydronephrosis: Case Report in an Infant of Seven Months. M. F. Campbell. *Am. Jour. Surg.*, March, 1933, XIX, 523-527.

Perirenal hydronephrosis is a rare condition and is usually misdiagnosed as renal neoplasm. The reported case is of unusual interest because of (1) the striking local pathology and (2) the tender age of the patient. Furthermore, it illustrates the importance of urologic conditions in juveniles. The etiology of the condition is unsettled; maldevelopment from primitive renal anlagen, exudation due to lymphstasis, trauma and infection have been suggested. The usual methods of urologic diagnosis may be of little help or may support the diagnosis of renal neoplasm. Excision of the cyst sac, and the kidney as well when it is of no value, is the treatment. With large cyst, a two-stage operation, drainage with secondary excision, is the wisest course. Because a less conservative attack, a one-stage operation, was employed in this case, death from surgical shock resulted.

DAVIS H. PARDOLL, M.D.

GOITER (THERAPY)

The Carbohydrate Metabolism in Patients with Toxic Goiter and its Alterations under the Influence of Roentgentherapy. E. N. Mojarowa. *Strahlentherapie*, 1932, XLV, 307-328.

The author carried out extensive studies of the blood sugar changes in patients with toxic goiter who were treated by roentgen rays. He finds that there is a definite disturbance of the carbohydrate metabolism in patients with a hyperfunction of the

thyroid. There is a definite hyperglycemia which depends to a great extent on the severity of the disease. Roentgentherapy tends to return the carbohydrate metabolism to normal. As a matter of fact, its fluctuations represent a very objective criterion of the response to radiation therapy.

ERNST A. POHLE, M.D., Ph.D.

GRENZ RAYS

Investigations Concerning Sensitization to Grenz Rays. C. Carrié. *Strahlentherapie*, 1933, XLVI, 697.

The author exposed mice to Grenz rays with and without sensitization by injection of fluorescent dyes (photodynamic substances). True sensitization was observed following the administration of hematoporphyrin and uroporphyrin. Epilation occurred following sensitization with doses which did not epilate uninjected animals. The time between exposure and epilation was also shortened. Similar sensitization could not be observed when ordinary roentgen rays were used. No skin injuries were noted over a period of three months; there was no permanent epilation.

ERNST A. POHLE, M.D., Ph.D.

KIDNEY

Pyelography in Injuries to the Kidney. H. C. Rolnick. *Am. Jour. Surg.*, April, 1933, XX, 40-44.

The material for this paper is based upon a series of 10 cases. Although the value of radiography in the early diagnosis of renal injuries is limited, the history of the injury, evidence of external trauma, and hematuria establish the diagnosis. Intravenous pyelography is preferred and will replace the retrograde methods.

Radiographic and pyelographic findings of interest and of diagnostic and prognostic importance may be obtained in injuries to the kidney in cases in which various degrees of damage to the parenchyma, calices, and pelvis have been produced.

DAVIS H. PARDOLL, M.D.

LIGHT THERAPY

Contribution to the Problem of Light Dosimetry. René du Mesnil de Rochemont. *Strahlentherapie*, 1933, XLVI, 731-756.

The author discusses at length various difficulties involved in accurate dosage in light therapy. He has determined a number of correction factors for certain lamps which permit the use of the iodine starch test even though the lamps emit different spectra.

ERNST A. POHLE, M.D., Ph.D.

LIVER

Hepatolienography in Laennec's Cirrhosis. Carlo C. Ricci. Arch. di Radiologia, March-April, 1933, XI, 343-351.

In the early stages of atrophic cirrhosis the liver is visible plainly after injection of thorotrast. It is invisible or demonstrable with difficulty in advanced stages, while the spleen is much denser and larger than normal.

E. T. LEDDY, M.D.

OFFSPRING, EFFECT ON

Studies on Children of Irradiated Mothers. E. Maurer. Strahlentherapie, 1932, XLV, 691-699.

In this contribution from Döderlein's clinic the author urges the creation of a central office where all cases of injuries to the offspring caused by irradiation of the mother may be reported. Several tabulations show a compilation of cases of this type scattered throughout the literature. A blank suitable for such centralized statistics is appended. This would eventually enable us to reach a definite conclusion in this important problem.

ERNST A. POHLE, M.D., Ph.D.

PELVIS

Dermoid Tumor of the Ovary. F. Marlow. Can. Med. Assn. Jour., July, 1932, XXVII, 57, 58.

This is a case report of a woman who had had two severe attacks of pain in the right lower abdomen. X-ray examination showed two small shadows low down in the right pelvis, about the junction of the right ureter and the bladder, with general haziness of the x-ray film in this area. The radiologist expressed the opinion that these were not ureteral stones. A bimanual pelvic examination revealed a tumor in the right pelvis. At operation this was found to be a dermoid tumor of the right ovary, with its pedicle markedly twisted. X-ray film of the tumor showed the small shadows previously observed.

L. J. CARTER, M.D.

PEPTIC ULCER (THERAPY)

Barium in the Free Peritoneal Cavity. A. A. Bagdassarov and M. J. Neporent. Röntgenpraxis, May, 1932, IV, 452-454.

Perforations of gastric ulcers during or shortly after barium examination are rare indeed. Such a case is described in detail. The patient experienced, on palpation before the screen, an excruciating epigastric pain. Surgery was not necessary. Forty

days after this occurrence, roentgen examination showed a large amount of barium in the peritoneal cavity. Three months afterwards the barium was still visible.

The authors conclude that palpation might cause perforation of a gastric ulcer, and that not every perforated ulcer, when treated conservatively, will lead to fatal peritonitis.

H. W. HEFKE, M.D.

PHYSIOTHERAPY

The Rôle of Physical Therapy in the Treatment of Precancerous and Cancerous Dermatoses. Joseph Jordan Eller. Jour. Am. Med. Assn., Feb. 11, 1933, C, 385-388.

The author discusses first the physical agents in one form or another, singly or combined, that play practically the entire rôle in the treatment of precancerous and cancerous skin lesions. One may choose, according to the type and size of the lesion, from the following: Radium; roentgen ray; Grenz ray; high frequency (a) cutting current, (b) electrodesiccation, (c) electrocoagulation; electrocautery; actual cautery; electrolysis; carbonic dioxide snow; curet; scalpel. The precancerous and cancerous dermatoses are tabulated and each one of the two groups is discussed as to the individual or combined agent best suited for treatment. The method used depends on the character of the lesion and its location.

C. G. SUTHERLAND, M.D.

THE PROSTATE

Problems of Prostatism Suggested by a Study of 100 Recent Cases. N. P. Rathbun. Am. Jour. Surg., March, 1933, XIX, 515-522.

The author gives a rather brief but interesting résumé on the subject of prostatism. He reviews the indications, pre-operative preparations, choice of anesthesia, type of operation, mortality, and post-operative complications.

Dr. Lowsley, Dr. Beer, and Dr. Simons, in their discussion of the paper, are in full accord with the remarks of Dr. Rathbun.

DAVIS H. PARDOLL, M.D.

Papillary Intracystic Adenocarcinoma of Prostate and Massive Benign Prostatic Cyst. B. S. Barringer. Am. Jour. Surg., April, 1933, XX, 51-53.

The author reports a papillary intracystic adenocarcinoma of the prostate and a massive benign prostatic cyst. Both of these cases are very rare, the latter possibly unique. There was no question in either case as to their prostatic origin: both of the cysts were in the median line; neither had any relation to the seminal vesicles. The cyst in the

second case pushed up behind the bladder between the fascia of the bladder base and the fascia of Denonvilliers.

Wesson, in an extensive and excellent résumé of the literature, reviews 29 cases of prostatic cysts, including four of his own. In but three of the cases reported were the prostatic cysts of large size and these were found at autopsy. In the large majority of cases retention of urine, partial or complete, was an important symptom. In most of these cases operated upon, the operation of choice was the opening or puncturing of the cyst by means of the cauterizer or by fulguration through the cystoscope. In 18 of the 29 cases, the prostatic cysts were found at autopsy. In apparently none of them was as extensive an operation done as was performed in the author's case.

Considering these lesions, there is one point that should be emphasized: they may be malignant and the patient should be carefully watched for a considerable period of time to determine whether or not the cysts are part of a malignant degeneration. If the cyst fluid is bloody, there is a greater chance that the condition may be malignant. The author has seen one case in which a distinct cyst showed in the position of the median lobe of the prostate. This cyst was punctured by means of the cystoscope, bloody fluid escaping. The condition was considered benign. Further observation, however, proved that the patient had a myosarcoma of the prostate. It was treated and cured by radium, the patient remaining well six years and dying of an intercurrent disease.

DAVIS H. PARDELL, M.D.

RADIUM

The Fate of Radio-active Substances in the Organism following the Drinking of Water Containing Radium Emanation. A. Fernau and H. Smereker. *Strahlentherapie*, 1933, XLVI, 365-373.

The authors have studied experimentally the fate of radium emanation in the organism following the drinking of radio-active water. The average amount of emanation remaining in the body five hours following the drinking of the water amounts to approximately 20 per cent of the initial value. Figures are given which permit the calculation of the amount of alpha and beta rays effective in the organism if the drinking of radio-active water is continued over longer periods.

ERNST A. POHLE, M.D., Ph.D.

SPINE (DIAGNOSIS)

The Narrowing of the Intervertebral Disk in the Early Stages of Pott's Disease. Desiderio Perotti. *Arch. di Radiologia*, March-April, 1933, XI, 251-256.

The author feels from his experience with several hundred cases of spondylitis that narrowing of the intervertebral disk is not the only evidence of early Pott's disease, but that, with the correct technique, there can be shown also small epiphyseal lesions.

E. T. LEDDY, M.D.

STOMACH

Total Gastrectomy for Carcinoma: Physiologic and Chemical Studies during a Period of Two Years following the Operation. Waltman Walters. *Jour. Am. Med. Assn.*, March 18, 1933, C, 804-806.

Physiologic and chemical studies have been made on repeated occasions over a period of two years on the patient whose case is here reported in detail and on whom successful total gastrectomy was performed for a highly malignant carcinoma. This patient was living and well at the time this paper was written, with no evidence of recurrence or metastasis of the malignant lesion. Physiologic and chemical studies would indicate that little change took place in the blood picture due to operation. This applies to the percentage of hemoglobin as well as to the number and morphologic characteristics of the erythrocytes and leukocytes. As one of the means of determining the effect of the loss of the acid and chloride normally secreted by the stomach, and absent as a result of the total gastrectomy, a study of alkaline tide would seem to indicate that such an alkaline tide was lacking. There was no change, however, in the excretion of chloride in the urine.

C. G. SUTHERLAND, M.D.

THE THORAX

Some Clinical and Radiologic Considerations of Malformation of the Ribs. Gastone Torelli. *Arch. di Radiologia*, March-April, 1933, XI, 288-315.

The author classifies and illustrates some cases of malformation of the ribs and discusses the changes they may produce in the physical examination of the thorax. He could find no relationship between malformation of the ribs and pulmonary tuberculosis.

E. T. LEDDY, M.D.

